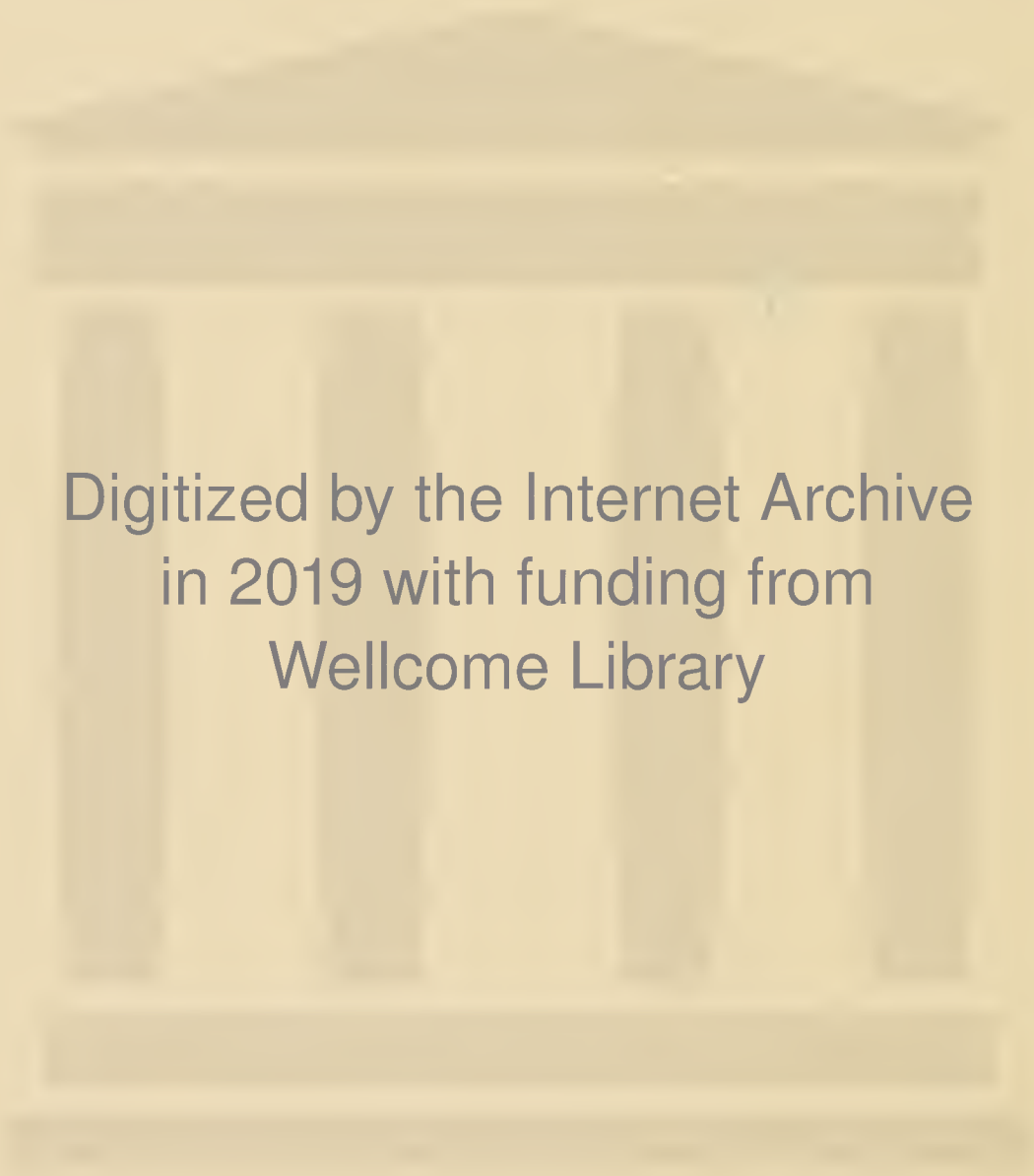
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THE

PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

VOL. II.—1842.

WITH NUMEROUS ILLUSTRATIONS.

LONDON:

G. BERGER, HOLYWELL STREET, STRAND;

AND ALL BOOKSELLERS.

CITY PRESS, 1, LONG LANE :
D. A. DOUDNEY.

PREFACE.

The Eighth Volume of the Penny Mechanic and Chemist being now concluded, we have again the pleasure to thank our numerous readers and correspondents for the great and very liberal patronage they continue to bestow upon the Work.

Taking into consideration the vast number of cheap literary periodicals which are almost daily being brought before the notice of the public, and the great exertions that are made to get them established in every part of the United Kingdom, it would naturally be supposed that each existing one must necessarily suffer in extent of circulation; but such, we are proud to say, is not the case with the Penny Mechanic and Chemist; and we think that our friends and patrons will require no assertions of ours to be assured, that the advantage and utility of such a publication, together with the estimation in which it is held, are sufficient, without any extraordinary exertion in the way of advertisements, to make it retain its standing in the favour of the public, and more especially of the working classes, for whose benefit it was more immediately designed.

To our friends who have long favoured us with their communications, as well as to those who have added themselves to the list of contributors during the past year, we present our most grateful acknowledgments, and assure them that we shall be at all times proud to receive for insertion any information which may be likely to prove beneficial to any class of

society ; or in reply to those who make known the subject on which they wish to be informed through the medium of our columns.

We trust that our endeavours in bringing forth the coming Volume, may be crowned with that success which has hitherto attended our labours, and that we may experience the same or greater satisfaction in addressing our friends at the end of it.

We commit our little bark, which has to this time withstood every storm of competition, into the ocean of public scrutiny and comparison ; and have not much fear but that the Eighth Volume will arrive at the end of its voyage, as fully laden with stores of public approval and patronage as its predecessors.

THE PENNY MECHANIC

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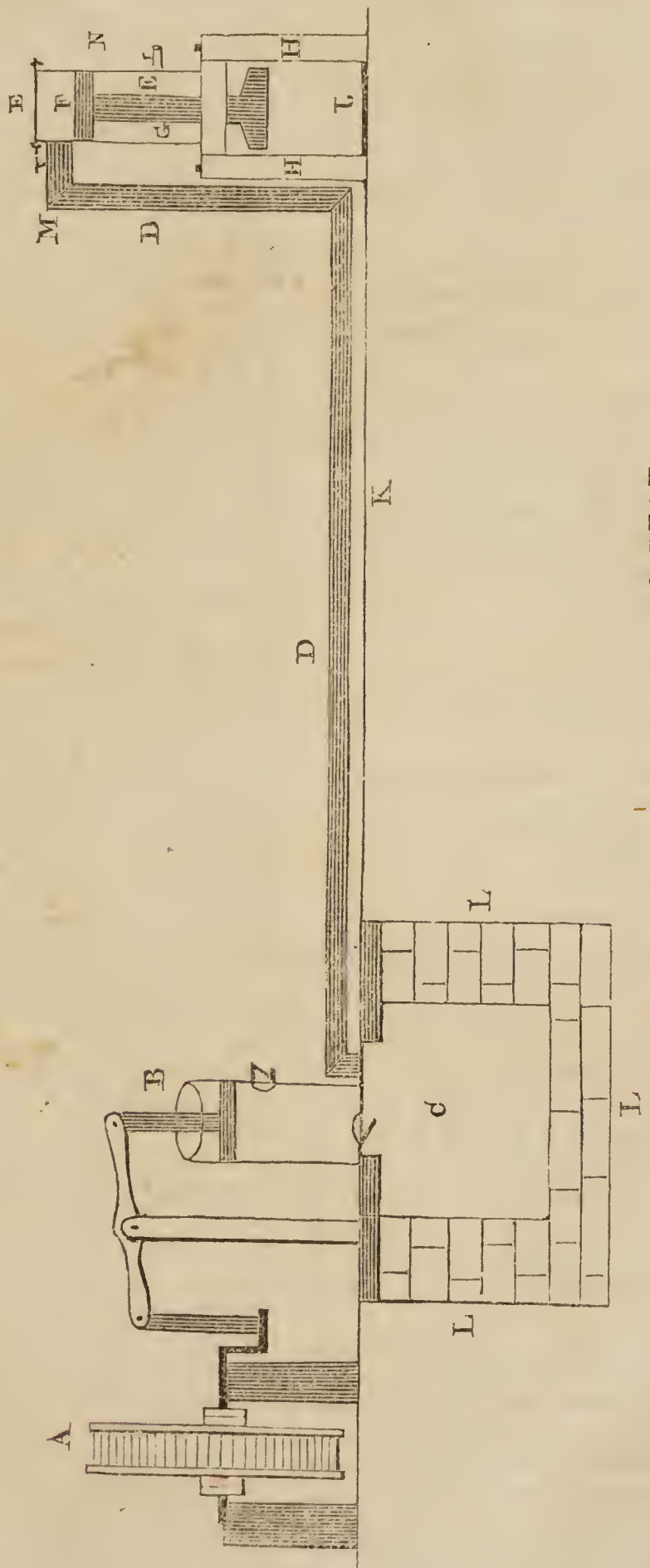
A MAGAZINE OF THE ARTS AND SCIENCES.

No. 60, THIRD SERIES. | SATURDAY, JAN. 1, 1842. | No. 308, OLD SERIES.



AIR-PRESS FOR COMPRESSING PEAT.

Vol. VIII.—No. 1.] [City Press, 1, Long Lane, Aldersgate Street: D A. Doudney.

AIR-PRESS FOR COMPRESSING PEAT.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—A week or two since, I sent you a sketch of a steam-press, begging the favour of your noticing it in your valuable Magazine; and, annexed, I beg to hand you a sketch of an air-press for the same purpose; and, as we have a good stream of water at the peat bogs to work the condensing pump, I shall feel greatly obliged by your noticing this also in your work, that I may have the opinion of your correspondents thereon, before I erect either.

I remain yours, &c.,

J. S.

Description of the Engraving.

A, water-wheel to work the condensing air-pump, B.

C, an air-chamber (on the upper part of which is a safety-valve), made of strong granite work, L L L, under the surface, for the pump to condense the air into.

D, a small iron pipe, about half-an-inch, to convey the air—no difference how far—to the pressing cylinder, E E.

F is the piston.

G, piston-rod or ram.

H H, frame-work.

J, bed for iron waggon to run under, loaded with peat to be pressed.

K K, level of surface.

M, cock or valve to turn in the condensed air on the piston.

N, another cock or valve, to turn it off when the press is down.

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS, &c.

To the Editor of the Penny Mechanic and Chemist.

Sir,—In Nos. 29 and 30 of the Penny Mechanic, page 227, I find it stated by "W. E. H.," that the tool used in slitting steel pens, "is an extremely fine-edged chisel—finer than any razor, but much harder, as it does not require to receive an edge during the whole of the day." This valuable property is attributed to a peculiar process adopted in forging—viz. the steel is said to be beaten for several hours with a hammer. That this is a most important fact, no one can for a moment doubt; and whether discovered by the pen-manufacturers or not, is a matter of little consequence.

Your correspondent, "W. E. H.," would have conferred a favour on every mechanic, had he pursued his inquiry a little farther, and ascertained the actual manipulation, by which the tenacity of steel is so materially increased; since, if the statement be correct, we shall have little occasion in future to temper tools used in turning, shaping, or otherwise cutting metal. It is essential, however, to know at what degree of heat the steel is to be hammered, and whether the tool is to be left at its greatest hardness, or drawn down to the first limit in the scale of tempering.

I have long been convinced, that the good or bad quality of a tool depends more on the care bestowed by the forger, than is generally imagined; and I am satisfied that the defects, whether of texture or edge, which too often present themselves in articles manufactured of steel, are to be traced, not so much to any natural imperfection or partial conversion of the metal, as to a slovenly and hasty mode of forging. In order to elucidate this, let us investigate the nature and properties of steel; and, in following up the subject, I shall have occasion to make frequent extracts from an excellent paper, by Mr. Cornelius Varley, entitled, "On Working Iron and Steel," which that gentleman presented to the Society of Arts.* Steel, it is well known, is made by combining carbon with iron, the atmosphere being excluded, and a white heat kept up, until the iron has imbibed, from the carbonaceous matter with which it is surrounded, a sufficient quantity: this may be, more or less, according to the use for which it is intended. Pure iron is very slightly altered† or increased in hardness by sudden cooling from a red heat; but the small amount of carbon which it receives during the process of cementation, greatly increases both its strength and toughness, leaving it alike malleable and ductile; and gives it that peculiarly valuable property of becoming extremely hard, if suddenly cooled, when at a red heat, by immersion in water. With this first dose of carbon, it is denominated *mild steel*, possessing all the valuable properties of iron with increased strength. A larger dose of carbon renders the metal susceptible of greater hardness, but it becomes more brittle in this state. It is also fusible, and, therefore, called *cast steel*; but, being less malleable, is more difficult to work.

Steel made by cementation, is designated *blistered steel*; because it is sup-

* 'Transactions of Society of Arts,' vol. 48, page 250.

† This is a disputed point. Mr Varley denies the hardening of iron—that is, of course, iron free from carbon

posed, while the carbon is entering, it meets with oxygen, hydrogen, or some foreign matter, which it causes to become gaseous,* and thus blisters the steel; but cast steel, being made by fusion, admits of an equal distribution of the carbon, to the expulsion of every other substance which cannot endure the intense heat.

The question, whether steel contains anything besides iron and carbon, is purely chemical, the consideration of which will form a theoretical illustration of the practical details of the present inquiry. A good workman merely requires metal free from flaws and perfectly homogeneous, and such as will harden at the lowest heat; for this test supersedes all others in proving the goodness of the steel and its fitness for the best purposes.

The soundness of cast steel is, obviously, a great recommendation; but the excess of carbon renders it harsh, and, consequently, intractable under the hammer; but, by being frequently heated and hammered, it may be reduced to the state of mild steel; the excess of carbon being burnt out during the repeated operation of forging, and then it must be the best steel for general use.†

Perfectly pure iron cemented in equally pure carbon, would, probably, make steel free from blisters; but, as in practice, these blisters are produced, and unavoidably so, it is needless here to inquire into their origin more minutely than we have already done; that blistered steel is unequally carbonized, the outside retaining the larger portion, is, I believe, admitted. It is fitted for the market by doubling and welding several times, by which means the parts are more intimately blended together, and the carbon more equally distributed: it is now called *shear steel.* These repeated weldings, although they tend to condense the metal, are apt to produce flaws; first, by imperfect union; secondly, by the carbon burning out of the commingling surfaces, thereby interposing a stratum of iron or imperfectly converted steel; and this, being softer than the surrounding particles, would give way during the extension of the steel; but, from whatever cause, such defects do very largely accompany this description of steel; and it is a question, whether any process short of fusion can totally remove them; yet it is ascertained, that long-continued forging essentially improves the soundness or homogeneity.

Besides these flaws, there is another obstacle often met with in steel—it is said to have *pins*; when turning or filing, it presents knots harder than the rest of the metal. I have met with these knots or pins of every degree of hardness, from mere harshness to absolute intractability; so that, while turning in the lathe, those parts would remain projecting out, and grind or break the edge of the tool, rather than submit to be cut away. I have filed some off, and found their hardness nearly approach that of the file. This inequality of texture causes the work to spring away from the tool, although it be firmly held by the rest, and renders it extremely difficult to turn true. Various causes have been assigned for these knots. Mr. Varley thinks they are portions of metal oversteeled—that is, so completely charged with carbon, as not to be softened by slow cooling. Mr. Clement, to whose ingenuity we are indebted for a most effective lathe for surface turning, states, that he broke the steel across these pins, having filed away the back to render it weak enough to part at the right place, when he found a cut or division; on which account he attributes the flaw and its extreme hardness to an oxide of iron, which prevented the union of the parts; an opinion which is, in some measure, borne out by the known hardness of the oxide of iron. It would be a curious, and by no means unprofitable, investigation, to analyse the condition of the surface of the deepest blisters, to ascertain whether they are alloyed or oxidised, or in any way differing in their state of carbonization from the more solid parts. It seems clear, that if these flaws occur from the presence of oxygen, the adjoining metal would be iron; for there would be a gradation from oxide, through iron, to the steel; therefore Mr. Varley concludes, the circumference of such a spot would be softest.

(To be continued.)

* "These blisters are obviously raised by a gas evolved in the interior of the bar, which had pushed up, by its elasticity, a film of the metal." —*Dr Thomson's Chemistry of Inorganic Bodies, vol. 1, p. 496.*

† This appears inconclusive, and very doubtful in its practical application.

BIOGRAPHICAL NOTICES.

No. IV.

SIR THOMAS GRESHAM.

Sir Thomas Gresham, descended from an ancient and respectable family, that took its name from Gresham, in the county of Norfolk, was born at London in the year 1519, being the youngest son of Sir Richard Gresham, Knight, who had served the offices of sheriff and lord mayor of

that city. That he might receive an education corresponding to his birth and expectations, he was sent to Caius College, then called Gonville Hall, in Cambridge. He resided here a considerable time, and made such an extraordinary proficiency in academical learning, that Caius, the founder of the college, styled him "Doctissimus Mercator," the very learned merchant. His views, however, were principally directed to the lucrative profits of commerce, by which his family had acquired great distinction and opulence. He was bound apprentice, therefore, to his uncle, Sir John Gresham, and was admitted a member of the Mercers' Company in the year 1543. He married, soon after, Mrs. Anne Read, the widow of William Read, Esq., of Fulham, in the county of Middlesex, and the daughter of William Fernley, Esq., of West Creeting, in the county of Suffolk.

In 1551 he was appointed agent to King Edward the Sixth, in the money transactions which that young prince was compelled to have in the city of Antwerp, in consequence of the embarrassed situation in which his finances had been left by King Henry VIII. Sir Richard Gresham, his father, had enjoyed this office before him; but his son did not succeed him when he died, until after Sir William Dansell had been previously appointed to the office, and displaced for mismanagement. On his appointment, Mr. Gresham removed, with his family, to Antwerp. His situation there was attended with such difficulties as would have overwhelmed a mind less fertile in resources, and less capable, on every emergency, of the most extraordinary exertions. He contrived, in fact, to discharge all the debts of his Majesty, which were very considerable; and by the advantageous turn which his admirable expedients gave to the exchange in favour of England, the price of all foreign commodities was not only greatly lowered, but gold and silver likewise, which before had been exported in large quantities, were re-imported in great abundance.

On the accession of Mary to the throne, Mr. Gresham was removed from his agency. Upon this he drew up a memorial, which was laid before her Majesty by the Minister of State. The services which, in this memorial, he represented that he had performed, not only for the late King, but for the nation in general, by the great increase both of money and trade, being universally allowed, he was soon reinstated in his former employment. His conduct, indeed, on every occasion, discovered such an uncommon genius in mercantile affairs, that, on the decease of Queen Mary, Queen Elizabeth took him immediately into her service, and employed him to buy up her arms. In 1559 she conferred the honour of knighthood upon him, and appointed him her agent in foreign parts. In this height of affluence and reputation, Sir Thomas Gresham determined to build a noble mansion for his own residence in the City; and, accordingly, he erected that large and venerable structure on the west side of Bishopsgate Street, London, which existed formerly under the name of Gresham College, and on the site of which the present Excise Office stood, 1791. But this rapid flow of prosperity did not continue long uninterrupted; for in the year 1564 he lost his only son, a fine youth of sixteen.

At this time the merchants of London met in Lombard Street, exposed in the open air to all the inclemencies of the weather. To remedy this inconvenience, Sir Richard Gresham, when sheriff, suggested a plan to the City, by which they might raise money for the building of a London Exchange; but nothing effectual was done, in his lifetime, toward the completion of this great design. Sir Thomas, however, adopted his father's views, and, improving upon his spirit, proposed, that if the citizens would give him a piece of ground in a proper place, large enough for the purpose, he would build a place at his own expense, with large and covered walks, where the merchants might daily assemble and transact business at all seasons, without any interruption from the weather. This generous offer was gratefully accepted, and in 1556, several houses upon Cornhill and the back of it, with three alleys, called Swan Alley, New Alley, and St. Christopher's Alley, containing in all eighty houses, were purchased by the citizens for 3532*l.*, and sold for 478*l.*, on condition of pulling them down and carrying off the materials. This done, the ground plot was made plain at the expense of the City, and possession given to Sir Thomas, therein styled agent to the Queen's Highness. On the 7th of June he laid the first stone of the foundation; and the work was forthwith followed with such diligence, that, by November, 1567, the building was covered with slate, and the shell shortly finished.

The plan of this edifice was formed upon the Exchange at Antwerp, being, like that, an oblong square, with a portico supported with pillars of marble—ten on the north and south sides, and seven on the east and west; under which stood the shops, each

seven feet and a half long, and five feet broad; in all 120. Twenty-five on each side, east and west, and thirty-four and a half north, and thirty-five and a half south, each of which paid Sir Thomas 4*l.* 10*s.* a-year, upon an average. There were, likewise, other shops fitted up at first in the vaults below; but the dampness and darkness rendered these so inconvenient, that the vaults were soon let out to other uses. Upon the roof stood, at each corner, upon a pedestal, a grasshopper, which was the crest of Sir Thomas's arms. This edifice was fully completed, and the shops opened, in 1569; and, on the 29th of January, 1570, Queen Elizabeth came from Somerset House, and caused it to be proclaimed by a herald and trumpet, "The Royal Exchange," and so to be called thenceforth, and not otherwise.

Though Sir Thomas had purchased very large estates in several counties of England, yet he thought a country-seat, near London, to which he might retire from business as often as he pleased, would be very convenient. With this view he bought Osterly Park, near Brentford, in Middlesex, where he built a large magnificent seat within the park, which he impaled, being well wooded and furnished with many fair ponds, stocked with fish and fowl—as swans and other water-fowl—and of great use for mills—as paper-mills, oil-mills, and corn-mills. In the same park was a very fair heronry, for the increase and preservation whereof, several allurements were devised by him*. But we must not omit a pleasing story relating to the house, which shows his great activity and despatch in anything he was determined to effect. Queen Elizabeth, having been once very magnificently entertained and lodged there by Sir Thomas, found fault with the court before it, as being too large; and said it would appear better if divided by a wall in the middle. He took the hint, and, to show his complaisance to her Majesty, immediately sent for workmen from London, who, in the night, built up the wall with such privacy and expedition, that the next morning the Queen, to her great surprise, found the court divided in the manner she had proposed the day before.

* "Norden's Speculum Britan.," p. 37. The mills show that Sir Thomas was of a disposition to blend profit with pleasure; but these and everything else soon began to decay after his death. This place has passed through several hands since his time; and, in 1791, was in possession of Lord Ducie, in right of his wife, relict of Robert Child, Esq., banker, of Temple Bar.

THE GREAT WESTERN RAILWAY ACCIDENT.

To the Editor of the Penny Mechanic and Chemist.

SIR,—In reference to the recent lamentable accident on the Great Western Railway, permit me to say, that I was lately an eye-witness of the inconvenience and danger to which the humbler passengers on that line are exposed.

Being too late for the mail-train, I was compelled to travel by the goods-train, which, by the railway time-bills, I was informed reached Bath between five and six in the morning. After taking a ticket, I found, to my great dismay, the passengers were "huddled" indiscriminately into a truck next to the engine and tender, and in front of sixteen or eighteen ponderous waggons, containing merchandise to the weight of, I should think, at least from 100 to 150 tons. In our progress we were exposed, not merely to the inclemency of the weather, but to the sparks issuing from the funnel, and the overplus steam, which was at frequent intervals liberated. Sometimes we travelled at not more than eight miles per hour; at other times, at not less than five-and-thirty in the same space of time; expecting every moment we should be run off the line, and smashed to atoms by the cumbrous load in our rear. Not the least regularity as to time was observed. At length, having reached Chippenham, we were informed, that as the Box Tunnel was under repairs, and had been for several days, the goods-train would not proceed for three or four hours—not until the next passenger-train should overtake us, which would command a suspension of the repairs until it had passed away.

That these repairs are absolute, and that an occasional delay should be the consequence, I am quite prepared to admit; but then, Sir, would it not have been more to the credit of the Great Western Railway Company, to prevent their servants from giving a misstatement of their times of arrival? Though, in the present instance, they were aware of the delay which would take place in the progress of the goods-train, as the tunnel had then been some days under repair when they issued the ticket to one of my fellow-passengers—a respectable tradesman of Bridgewater (who likewise had missed the mail-train)—they distinctly stated that the train would reach Bridgewater at an early hour in the morning, according to the time specified in the weigh-bills.

But, Sir, this is not all of which we had to complain. After being detained at Chippenham for four hours—the time for the next passenger-train being nearly due—we asked permission to proceed with it upon payment of the additional fare. Could anything have been more reasonable? But this was peremptorily refused; and I was compelled (my fellow-passenger not being disposed to submit to the imposition) to cancel my former ticket, and pay the full fare from Chippenham to Bath!

Permit me, in conclusion, to state that, from what I witnessed during that journey, the Great Western Railway Company are culpable with respect to the recent accident; that lamentable sacrifice of human life is chargeable to their heartless practice of placing the passengers so near the engine. To excuse themselves for which, they may plead the trouble and inconvenience of increasing or diminishing the number of goods-waggons at the different stations; but such an argument has no weight. Upon the occasion to which I refer, when it suited their purpose, they found no difficulty in detaching our truck from the waggons, proceeding to the points, and then running back upon an inner line to take up two or three additional waggons, to place before those which had previously composed the train. This proves that the trains are not, as is generally supposed, lengthened or diminished by the hindermost waggons. The additions are as frequently made at the fore as at the hind part of the train.

I remain yours, &c.

A.

THE CHEMIST.

COMBUSTION.

(Continued from page 461.)

IV. None of the products of combustion are combustible, according to the definition of combustion here given. This want of combustibility is not owing to their being saturated with oxygen; for several of them are capable of combining with an additional dose of it. But, during this combination, no caloric or light is ever emitted; and the compound formed differs essentially from a product of combustion; for, by this additional dose of oxygen, the product is converted into a supporter. Hence we see that combustion ought not to be confounded with the combination of a body with oxygen, as was done formerly.

Combustion, indeed, cannot take place without the combination of oxygen; but oxygen may combine with bodies in different proportions, without the phenomena of combustion; and the product obtained, is capable of becoming converted into a supporter of combustion; for instance, if lead be melted, and kept so for some time, it becomes covered with a white pellicle, or white oxide of lead—a product consisting of oxygen and lead; but if this white oxide is suffered to be heated longer, it absorbs an additional quantity of oxygen, and becomes converted into a yellow powder, called yellow oxide of lead. If this yellow oxide be again exposed to heat, it absorbs still more oxygen, and becomes converted into red oxide of lead. All these oxides are, therefore, supporters. When the supporters, thus formed by the combination of oxygen with products, are made to support combustion, they do not lose all their oxygen, but only the additional dose which constituted them supporters. Of course, they are again reduced to their original state of products of combustion. Hence it follows, that they owe their properties, as supporters, not to the whole of the oxygen which they contain, but to the additional dose which constituted them supporters. We may, therefore, call them partial supporters; indicating, by the term, that part only of their oxygen is capable of supporting combustion, and not the whole.

All the partial supporters with which we are acquainted, contain a metallic basis; for metallic oxides are the only products at present known, capable of combining with an additional dose of oxygen. It is a circumstance highly deserving attention, that when metals are capable of combining with several doses of oxygen, the product, or oxide formed by combustion, is seldom or never that which contains a maximum of oxygen.

Thus it is evident, that several of the products of combustion are capable of combining with oxygen. The incombustibility of products, therefore, is not owing to their want of affinity for oxygen, but to some other cause.

V. No product of combustion is capable of supporting combustion. This is not occasioned by any want of affinity to combustible bodies; for several of them are capable of combining with an additional dose of their basis. But, by this combination, they lose their properties as products, and are converted into combustibles. The process, therefore, differs es-

sentially from combustion. Thus sulphuric acid, a product of combustion, by combining with an additional dose of sulphur, or its oxide, is converted into sulphureous acid; a substance which, from several of its properties, the doctor concludes to be combustible. Thus, also, phosphoric acid, a product of combustion, is capable of combining with phosphorated hydrogen, and of forming phosphorous acid, a combustible body. When this last acid is heated in contact with a supporter, it undergoes combustion; but it is only the additional dose of the combustible which burns, and the whole is converted into phosphoric acid. Hence we see that it is not the whole basis of these compounds which is combustible, but merely the additional dose. The compounds, therefore, formed by the union of a product and combustible, may be termed partial combustibles; indicating, by the name, that a part only of the base is capable of undergoing combustion. Since the products of combustion are capable of combining with oxygen, but never exhibit the phenomena of combustion, except when they are in the state of partial combustibles, combustible bodies must contain a substance which they lose in burning, and to which they owe their combustibility; for, after they have lost it, they unite to oxygen without exhibiting the phenomena of combustion.

Though the products of combustion are not capable of supporting combustion, they not unfrequently part with their oxygen, just as supporters do, give it out to combustibles, and convert them into products; but, during this process, no heat nor light is ever evolved. Water, for instance, gives out its oxygen to iron, and converts it into black oxide, a product; and sulphuric acid gives out its oxygen to phosphorus, and converts it into phosporic acid. Thus, we see, that the oxygen of products is capable of converting combustibles into products, just as the oxygen of supporters; but during the combination of the last only, are heat and light emitted. The oxygen of supporters then contains something which the oxygen of products wants.

THE GENERAL RECIPE BOOK.

Tooth Powder.—Take ½ oz. of powdered gum myrrh; 1 oz. of powdered bark; 2 drachms of cream of tartar; 1 drachm of bole ammoniac. Mix in a mortar. A constant use of this powder will cause the teeth to obtain a beautiful whiteness, and preserve them from decaying, and prevent the toothache.

Permanent Red Ink, for Linen.—Take ½ oz. of vermilion, and 1 drachm of salt of steel; let them be levigated with linseed oil, to the thickness or limpidity required for the occasion.

Mock Indian Ink.—Dissolve six parts of isinglass in twice its weight of boiling water, one part of liquorice in two parts of boiling water. Mix both together while warm; then incorporate, by little at a time, on a stone with a spatula, one part of the finest ivory black. When the mixture has been perfectly made, heat it in a water-bath till the water has evaporated; it will then form a paste. Any form may be given it, by moulding it as usual.

White Ink for Writing on Black Paper.—Having carefully washed some egg-shells, remove the internal skin, and grind them on a piece of porphyry; then put the powder in a small vessel of pure water, and, when settled at the bottom, draw off the water, and dry the powder in the sun. This powder must be preserved in a bottle. When you want to use it, put a small quantity of gum ammoniac into distilled water, and leave it to dissolve during the night. Next morning the solution will appear white; and, if you strain it through a linen cloth, and add to it the powder of egg-shells, you will obtain a very white ink.

Never-yielding Cement.—Calcine oyster-shells, pound them, and sift through a sieve; grind them on a flat smooth stone with a muller, till they are reduced to the finest powder; then take the whites of several eggs, according to the quantity of powder, form the whole into a paste. With it join the pieces of china or glass, and press them together for six or eight minutes. This cement will stand both heat and water.

The Art of Bronzing.—Bronzing is that process by which figures of plaster of Paris, wood, &c., are made to have the appearance of copper or brass. It is as follows:—Dissolve copper filings in nitric acid; when the copper is dissolved, pour off the acid solution, and put into it some pieces of iron filings. The effect of this will be, to sink the powder to the bottom of the acid. Pour off the liquor, and wash the powder in successive quantities of fresh water. When the powder is dry, it is to be rubbed on the figure with a soft brush or piece of leather; but observe, that before the application of the bronze powder, a sort of green is to be laid on the figure; and, if you wish the powder to

adhere stronger, mix it with gum water, lay it on like paint, or previously trace the parts to be bronzed, with gold size, and, when nearly dry, rub the powder over it.

To take Rust out of Steel.—Sweet oil must be well rubbed over it, and, in forty-eight hours, use unslaked lime, powdered very fine; rub it till the rust disappears.

A Liquor to Remove Spots, &c.—Dissolve two ounces of pearlash in a quart of spring water, to which add two lemons, cut into small pieces. Mix this well, and keep it in a warm state two days, by placing it near the fire; strain it off, and keep it in a bottle for use. To use it, pour a little upon the water, and, when it disappears, wash the part in cold water. This is a useful article to remove pitch, grease, &c.

MISCELLANEA.

Exhaustion of Materials in the Production of Iron.—As five cubic feet of iron make a ton nearly, so our whole annual manufacture is three millions and a half of cubic feet, which, in each dimension, is 152 feet, or 50⅔ yards nearly. Then, as there are about 147 thousand millions of cubic feet in a cubic mile, so, at the same rate, it would require 42,000 years to make a solid mile of iron! But as the mine, coals, and lime, make ten tons for every ton of iron, and their specific gravity is but one-third of the iron; so a cubic mile of iron would exhaust thirty cubic miles of materials, and our annual waste dug from the earth is 105,000,000 of cubic feet, and make a cubic exhaustion, or pit, of a mile in 1400 years.—*Phillips.*

The Mechanical Power of Machinery has been estimated by Marshall at 12, and its consuming power at only 1; hence the miseries inflicted on labourers, for the manufacturers are not a seventh of the population; and their machinery supercedes the domestic labour of half the cottage population.—*Phillips.*

Consumption of Coals.—The whole quantity of coals put in freight, is about seven million tons, and canals and railways convey about eleven millions more. A million tons of pig iron consumes about four million of tons, and, in bar and cast, another million. Practical men reckon the entire consumption at thirty-five or forty million tons.

Spawn of Fish.—The cod, according to Leuwenhoeck, annually spawns nine millions of eggs; the flounder a million; the mackerel half-a-million, the herring 10,000, the carp a quarter of a million, the perch more, and the sturgeon six or seven millions. Of the viviparons, the blenny brings forth two or three hundred. The spawn of one genus is mostly devoured by others, and not one egg in a hundred is supposed to be hatched.

Experiments with Spiders.—Numerous experiments have been made to obtain the threads of spiders to use as silk. Four thousand were at one time collected, but they soon destroyed each other. It required twelve spiders to produce the quantity of one silk-worm, whose cocoons weigh three or four grains; while a spider produced but half-a-grain. So that a pound of silk produced by 2300 worms, would require 27,000 spiders, and all females. But there are some spiders in Java, whose webs require a knife to cut them.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 20, Southampton Buildings, Chancery Lane.—Wednesday, Jan. 5, H. Brown, Esq., on the Phenomena of the Human Character. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, Jan. 6, Edward F. Rimbault, Esq., on the Music of the Age of Elizabeth and James. At half-past eight.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, Jan. 4, Mr. Wilby, on Vital Education. At eight o'clock.

QUERIES.

I wish to be informed if Mr. Blackwell has obtained a patent for a curling-comb?

T. Collins.

The best process of annealing cast iron, made either by hot or cold blast? C. R.

ANSWERS TO QUERIES.

Universally to Determine the Power of a Machine, divide the velocity of the action by the velocity of the power. For the actual effect, multiply this by the force of the power, and deduct a fourth for friction. In wheel machinery, to determine the number of revolutions of the last-moved part, divide the product of the cogs in the driving wheels by the product of the cogs in the driven. Alpha.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country

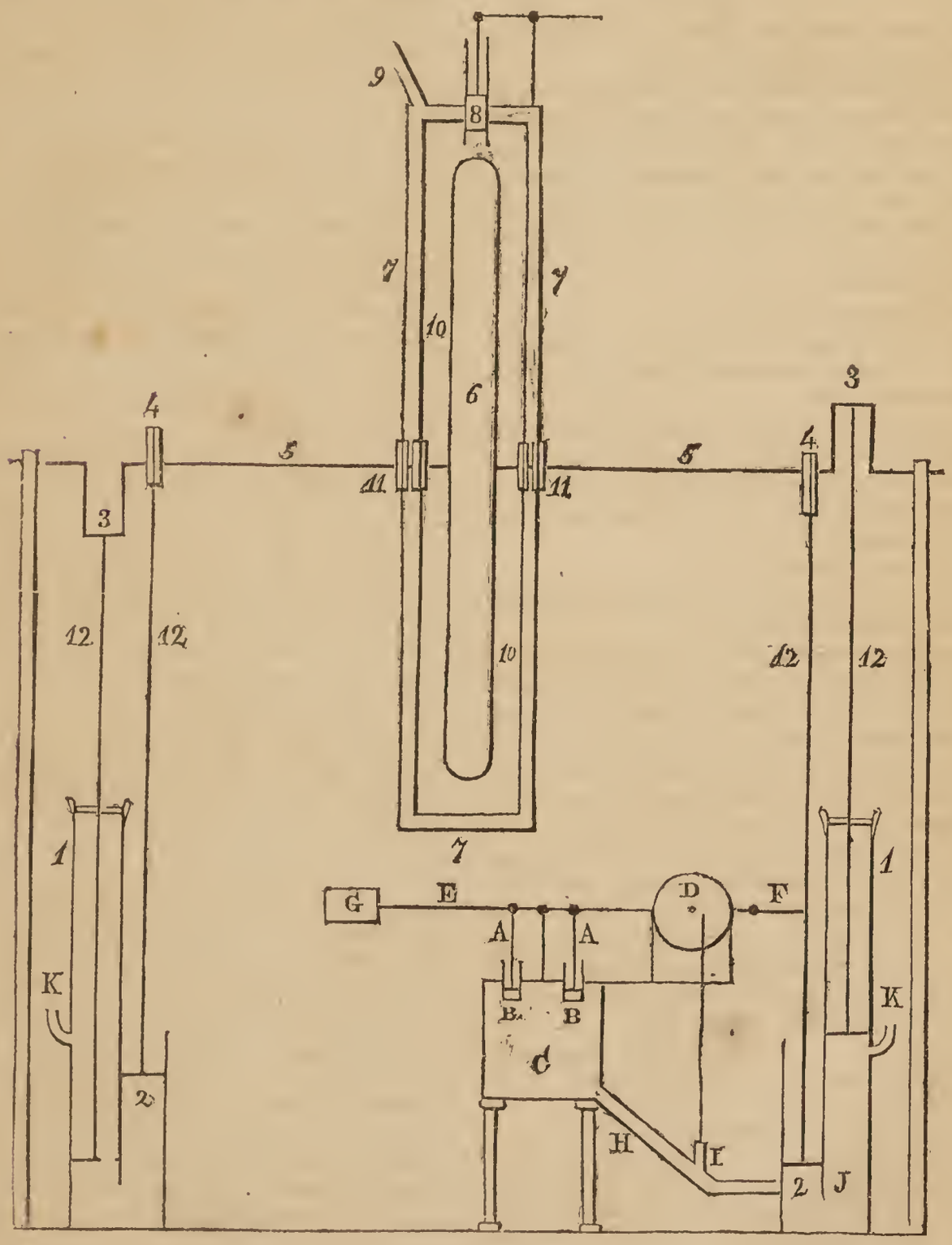
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 61, THIRD SERIES. | SATURDAY, JAN. 8, 1842. | No. 309, OLD SERIES.

BAXTER'S ATMOSPHERIC ENGINE.



Vol. VIII.—No. 2.] [City Press, 1, Long Lane, Aldersgate Street: D A. Doudney.

BAXTER'S ATMOSPHERIC ENGINE.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—If you think the above worth a place in your valuable work, it is at your service.

Figure 1 represents two cylinders.

2, two cylinders, with a hole in the cylinder-rods, made in the same way as pumps.

3, cranks working with the cylinder-rods.

4, two eccentric wheels, working the air-pumps or small cylinders.

5, the crank-bar, on which is the fly-wheel, in an exhausted tube, surrounded by water in the other tube, which gives more power to the working cylinders by one-third; the fly-wheel not having to combat with the air, as shown in the engraving.

6, fly-wheel.

7, water-tube.

8, the air-pump to make the vacuum.

9, the pipe where the water is put into the water-tube.

10, the vacuum, or the exhausted tube, where the fly-wheel works.

11, the safes; they keep the air from the water in the tube, and the water out of the vacuum.

12, the cylinder-rods.

A B, the air-pumps, which press the air into the air-box, C.

D, the wheel on which are the teeth or catches, with which the lever, F, works.

The lever is fastened to the air-pumps; when they rise, the lever strikes the wheel and sends it round, and the wheel strikes the lever and presses it down; the weight on the other end forces it down that way when the wheel is off the lever. To gain the starting motion, the valve, I, is opened; the air that is pressed together in the air-box, rushes down the pipe, H, and through the valve, I, into the cylinder, J, and out at the aperture, K.

I remain yours, &c.,

Frederick Baxter.

Glasshouse Street, Nottingham.

On a well-constructed railway, a ton is drawn by a force of seven pounds and a half, whether the force be derived from steam, or from a weight acting over a pulley. Hence, a force of twenty-five pounds would draw a stage-coach with its luggage and passengers, which usually weighs about three tons.—*Phillips.*

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS, &c.

(Continued from page 3.)

As an excess of carbon renders steel harder and more brittle, therefore an inequality is liable to occur. This may be illustrated by the known fact, that portions of an iron casting, intended to be soft, are hardened by contact with the moist sand of which the mould is formed; and those parts nearest the outside, break with a fracture more glassy than even hard steel. Now good steel, hardened by sudden immersion in cold water, when at a red heat, will invariably become soft by slow cooling from such heat, and more equally so, if the external atmosphere be carefully excluded; but this hard cast iron, on the contrary, does not; it requires to be exposed for many hours to a great heat, and must not be smothered by fuel, to prevent the escape of the superabundant carbon with which it is charged; but the air should be allowed free access, that some portions of the carbon may burn out, while the remainder has a tendency to equalize itself; then, if slowly cooled, the entire mass will be found sufficiently annealed.

The knots or pins in steel are rarely removed by slow cooling; and to burn them out would spoil the steel, because it has no carbon to spare but in the pins (supposing this to be the cause of their hardness); and the process of annealing in air-tight vessels, is not found to produce equality sufficient for any good purpose.* Even cast steel, which is undeniably purer and more homogeneous than any other description, is liable to long streaks or veins, harder than the other portions of the bar. All these defects show the necessity of greater and more minute attention to the improvement of steel, than the subject has hitherto received; and, for this purpose, two modes of hammering are indispensable. In order to illustrate this, let us take any article forged in the usual way not out of the blistered or sheer steel (both of which may be supposed to contain carbon unequally distributed) but of cast steel, which, having been fused, and passed through the rolls, or under a ponderous tilt-hammer, is characterised as refined and homogeneous. Yet notwithstanding every precaution, we still see the labour and skill of the machinist de-

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* I have discussed this subject in No. 22, page 171, and explained a sure way of getting rid of these pins or knots in steel.

feated by those veins, fissures, and knots, of intractable hardness, which denote either metal of inferior quality, or that the original texture of the steel has been deteriorated by the ignorance and carelessness of the forge-smith. The first supposition does not apply to cast steel, in which the dose of carbon is equally diffused throughout the mass, or so nearly so, as to render the difference inappreciable. We are, therefore, compelled to admit the second position; and this (if I be not much deceived) will enable us to account for past failures, and guard against future disappointment.

I now proceed to describe the twofold process of hammering, by which the greater part, if not the whole, of the defects pointed out, may be corrected. It is necessary, in the first place, to hammer the steel at a forging heat, so as to knead the parts together, and keep them moving among themselves. This should be continued till the different qualities are not only intimately blended, but, as it were, dissolved in each other, so as to insure perfect homogeneity; for the carbon, being thus spread, will discover and expel every particle of oxygen; the metal will thus be rendered as sound as we can expect from cemented steel; since it is clear, that if free from oxygen and every other foreign matter, except the carbon, there is nothing to prevent a perfect union of the parts while under the hammer. Good steel consists of that proportion of carbon and iron which, combined, form the strongest and toughest compound; each purer portion, therefore, when brought into contact by the hammer, remains so, and resists its percussive force the more, from the greater cohesion of the particles. Hence the redundant or deficient portions suffer most, till they become equalized, and the cruder impurities are either beaten out, or formed into a homogeneal compound with the entire mass.

Having, by this means, obtained sound steel, it is far from being in a perfect state, being still very unequal in density, and in a state of distraction; some portions close and dense, others squeezed out, and some nearly rent asunder: a second hammering, therefore, becomes necessary at a particular heat, and under circumstances required by the shape of the steel —such as recesses in the anvil, or blocks laid thereon, technically termed swedges and moulds. For this purpose, the metal is first brought, as near as eligible, to the required dimensions, and is then to be hammered, in order to close and condense the particles equally and throughout, yet leaving every part in a state of rest and ease—a condition very essential for good springs, and, indeed, every article formed of steel, that has to vibrate or act by tension; for, if one part be denser than another or more at ease, the less dense, or, in other words, the weaker parts will have most, if not all, of the play, and, consequently, will soonest break. The common remedy for these accidents proves, that the proximate cause is unknown, or, if known, disregarded. Thus, if a spring breaks, it is frequently replaced by an ignorant workman, by what he calls a stronger—that is, a heavier one; not considering that, by this increased weight of metal, he loses a portion of the play, and what remains is still imposed upon the weakest parts. Again, we find axletrees, apparently sound and free from flaw, suddenly snap, perhaps from the pressure of a violent jerk or shock, which requires, to be innocuous, that every part should yield equally; for the axiom is here incontrovertible, that the strength of the whole is only that of the weakest part, rendered less so by the weight and stiffness of the stronger parts.

This second hammering is also intended to prepare the steel for receiving the utmost hardness of which it is susceptible, —a quality which entitles it to be considered the *master metal*—the one by which we give shape and form to all the others. I must here observe, that although steel at a red heat, when suddenly plunged in cold water, becomes both brittle and hard, its toughness or tenacity, even in this state, greatly exceeds that of any other brittle substance. We must also bear in mind, that this characteristic hardness cannot be given in part, but always in full, and to its highest limit; and so true is this, that in a piece of steel, a portion of which is hard and a portion soft, no gradation of hardness can be detected; the parts adjacent to the hard portion being quite soft, or, as some think, softer than if slowly cooled. This singular fact has been thus accounted for:*—Suppose a rod of well-hammered steel to be heated at one end for hardening, there will be a gradation of temperature from the coldest to the hottest extremity, and the annealing or reduction of that hardness, which it has received from the hammer, will be in proportion to the heat; consequently, the rod will be softer and softer towards the end, where the heat is applied. On plunging the bar into cold water, that portion which had become sufficiently hot

* On the authority of Mr. Cornelius Varley.

to harden, is rendered quite hard; but that part immediately adjacent to it will be found to be most annealed, and will endure more twisting and bending than any other. But although this hardness must be imparted in its fullest extent, it may, nevertheless, be lowered in any assignable degree—that is, a portion of its brittleness may be removed by the application of moderate heat, a greater portion by more heat, and so on, as the purposes may require: this is called *tempering*. If hard steel be brought to a red heat, and then suffered to cool slowly, it will become as soft as if never hardened. This is called *softening*, and is distinguished from *annealing*, which is a similar process of slow cooling; but, applied to steel, iron, or brass, merely to remove all mechanical condensation, whether by hammering or otherwise; for if metal has been altered in shape by the hammer or any other process, as much as it will endure without breaking, then by annealing it will be softened, and may again be bent or altered in form, as often as requisite.

(To be continued.)

BIOGRAPHICAL NOTICES.

No. V.

SIR THOMAS GRESHAM.

Before the seat in Osterly Park was completed, Sir Thomas Gresham projected and executed that noble design of converting his mansion, in Bishopsgate Street, into a seat for the Muses, and endowing it with the revenues arising from the Royal Exchange after his decease. Accordingly, by an indenture dated May 20, 1575, he made a disposition of his several manors, lands, tenements, and hereditaments; with such limitations and restrictions, particularly as to the Royal Exchange and his mansion, as might best secure his views with regard to the uses for which he designed them. This indenture was soon followed by two wills—one of his goods, and the other of his real estates; the former of these bears date July the 4th, ensuing, whereby he bequeaths to his wife, whom he makes his sole executrix, all his goods—as ready money, plate, jewels, chains of gold, with all his stock of sheep and other cattle, if within the realm of England; and likewise gives several legacies to his relations and friends, and to all his servants, amounting, in the whole, to 2000*l.*, besides some small annuities. The other will is dated July the 5th, wherein he gives one moiety of the Royal Exchange to the mayor and commonalty of London, and the other to the Mercers' Company, for the salaries of seven lecturers, in divinity, law, physic, astronomy, geometry, music, and rhetoric, at 50*l.* per annum each, with his house in Bishopsgate Street, for the residence of the lecturers, where the lectures were to be read. He likewise leaves 536*l.* 8*s.* yearly, for the provision of eight almsfolks, residing in the almshouses behind his house, and 10*l.* yearly to each of the prisons in Newgate, Ludgate, King's Bench, the Marshalsea, and Compter, in Wood Street; and the like sum to each of the hospitals of Christchurch, St. Bartholomew, Bedlam, Southwark, and the Poultry Compter; and 100*l.* yearly, to provide a dinner for the whole Mercers' Company in their hall, on every quarter day, at 25*l.* each dinner. By this arrangement, sufficient care was taken, that the two corporations to whom the affair was intrusted, should receive no damage by the execution of it; for the stated annual payments amount to no more than 603*l.* 6*s.* 8*d.*, and the yearly rents of the Exchange received by Sir Thomas, were 740*l.*, besides the additional profits that must arise from time to time by fines, which were very considerable. But the Lady Anne, his wife, was to enjoy both the mansion and the Exchange during her life, if she survived Sir Thomas; and then they were both vested in the two corporations, for the uses declared in the will, for the term of fifty years; which limitation was made on account of the statutes of mortmain, that prohibited the alienation of lands or tenements to any corporation, without licence first procured from the crown. And that space of time the testator thought sufficient for procuring such licence, the doing of which he earnestly recommends to them without delay; in default thereof, at the expiration of fifty years, these estates were to go to his heirs at law.*

Having thus settled his affairs so much to his own honour, the interest of the

* This was Elizabeth, sole child of his elder brother John, married to Sir Henry Nevil. She died in 1573, before Sir Thomas; but left issue, Henry Nevil, Esq., to whom Sir Thomas bequeathed, by his will, the manors of Maytield and Wadhurst, with all the lands belonging to them, amounting to 240*l.* per annum, after his lady's death. Sir Thomas had also, by a woman of Bruges, in Flanders, a natural daughter, named Anne, to whom, upon her marriage, he gave the manors of Hemesby Morton and Jernyham, in Suffolk, amounting, in the whole, to 280*l.* 15*s.* per annum. She married Nathaniel

public, and the regards due to his family, he was at leisure to reap the fruits of his industry and success; but he did not long enjoy this felicity, for, on the 21st of November, 1579, coming from the Exchange to his house in Bishopsgate Street, he suddenly fell down in his kitchen, was speechless, and presently died. He was buried in his own parish church of St. Helen. His obsequies were performed in a very solemn manner, the corpse being attended by 100 poor men, and the like number of poor women, whom he had ordered to be clothed in black gowns at his own expense. The charges of the funeral amounted to 800*l*. His corpse was deposited in a vault at the north-east corner of the church, which he had before provided for himself and family, with a curious marble tomb over it; on the south and west sides of which are his own arms, and on the north and east the same, impaled with those of his lady. The arms of Sir Thomas, together with those of the City of London and of the Mercers' Company, are likewise painted in the glass of the east window of the church above the tomb, which stood, as he left it, without any inscription, till 1736, when the following words, taken from the parish register, were cut on the stone that covers it, by order of the churchwardens:—"Sir Thomas Gresham, Knight, was buried December 15th, 1579." By an inventory of the goods at his house in Bishopsgate Street, taken after his decease, they are said to have amounted to 1127*l*. 15*s*. 8*d*. He had also another house at West Aire, in Norfolk, where the effects were valued at 1655*l*. 1*s*.; but his chief seat seems to have been at Mayfield, in Sussex; one room of which was called "the queen's chamber," and the goods and chattels belonging to it were estimated at 755*l*. 10*s*. 8*d*. By his death, many large estates, in several counties of England, amounting, at that time, to the clear yearly value of 2300*l*. and upwards, came to his lady, who survived him many years, and continued to reside, after his decease, in her mansion, at London, in the winter, and at Osterly Park in the summer season; at which latter place she died, Nov. 23rd, 1596. Her corpse was brought to London, and buried in the same vault with her husband.

Mr. Ward, in his "Lives of the Professors of Gresham College," has drawn the character of Sir Thomas Gresham:—He observes, "That he had the happiness of a mind every way suited to his fortune, generous and benign; ready to perform any good actions, and encourage them in others. He was a great friend and patron of our celebrated martyrologist, John Fox. He was well acquainted with the ancient and several modern languages. He had a very comprehensive knowledge of all affairs relating to commerce, whether foreign or domestic, and his success was not less, being, in his time, esteemed the greatest commoner in England. He transacted Queen Elizabeth's mercantile affairs so constantly, that he was called 'The Royal Merchant;' and his house was sometimes appointed for the reception of foreign princes upon their first arrival in London. As no one could be more ready to perform any generous actions which might contribute to the honour of his country, so he knew how to make the best use of them for the most laudable purposes. Nor was he less serviceable, both to the queen and her ministry, on other occasions; who often consulted him, and sought his advice in matters of the greatest importance relating to the welfare of government. But the most shining part of his character appears in his public benefactions. The Royal Exchange was not only a singular ornament to the City of London, and a great convenience to the merchants who wanted such a place to meet and transact their affairs in, but likewise contributed very much to the promotion of trade, both by the number of shops erected there, and the much greater number of the poor who were employed in working for them; and the donation of his own mansion for a seat of learning and the liberal arts, with the handsome provision made for the endowment and support of it, was such an instance of a generous and public spirit, as had been equalled by few, and must perpetuate his memory with the highest esteem and gratitude, so long as any regard to learning and virtue is preserved among us. Nor ought his charities to the poor, his eight almshouses, and the liberal contributions to the ten prisons and hospitals in London and Southwark, to be omitted. Each of those benefactions, separately considered, is great in itself, and a just foundation for a lasting honour; but, when united, they are without any rival, peculiar to Sir Thomas Gresham; who, having no son to bear up his name, very wisely fixed on the most effectual method to preserve it in the highest regard to all posterity." His public benefactions, the Royal Exchange, and his man-

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Bacon, Esq., second son of the Lord-keeper, Sir Nicholas Bacon, who also married Jane, youngest sister to the lady of Sir Thomas Gresham.

sion, on the decease of his lady, immediately came into the hands of the two corporations—the City of London and the Mercers' Company—who, according to their trust, obtained a patent from the crown, dated February 3rd, 1614, 12 Jacobi I, to hold them for ever upon the terms expressed in the will of the donor. The lectures were read, when a certain number of auditors were present, in a room in the Royal Exchange, A.D. 1791.

THE CHEMIST.

COMBUSTION.

(Continued from page 6.)

VI. Whenever the whole of the oxygen is abstracted from products, the combustibility of their base is restored as completely as before combustion; but no substance is capable of abstracting the whole of the oxygen, except a combustible, or a partial combustible. Water, for instance, is a product of combustion, whose base is hydrogen. To restore the combustibility of the hydrogen, we have only to mix water with iron or zinc filings, and an acid; the metal is oxidated, and the hydrogen gas is evolved as combustible as ever. But no substance, except a combustible, is capable of separating hydrogen gas from water, by combining with its oxygen. Thus we see that combustibles are capable of restoring the combustibility of the bases of products; but they themselves lose their combustibility by the process, and are converted into products. Combustibility, therefore, may be thrown at pleasure from one body to another.

From these facts it is obvious, that the products of combustion may be formed without combustion; but, in these cases, a new combustible is always evolved. The process is merely an interchange of combustibility; for the combustible is converted into a product only by means of a product. Both the oxygen and the base of the product, having undergone combustion, have lost something which is essential to combustion. The process is merely a double decomposition. The product yields its oxygen to the combustible, while, at the same time, the combustible gives out something to the base of the product; the combustibility of that base, then, is restored by the loss of its oxygen, and by the restoration of something which it receives from the other combustible thus converted into a product.

There is, indeed, another method of forming the products of combustion, without actual combustion in certain cases; but the phenomena are much more complicated. This method is, to expose them to the action of some of the supporters dissolved in water; especially nitric acid. Thus, most of the metallic oxides may be formed without combustion, by the action of that acid on the metals. But, in that case, a new supporter is always evolved—namely, nitrous gas; ammonia is also usually formed, and, not unfrequently, the product is converted into a partial supporter.

No supporter can be produced by combustion, or by any equivalent process. As all the supporters, except oxygen gas, consist of oxygen combined with a base, it follows, as a consequence, that oxygen may combine with a base without losing that ingredient, which occasions combustion. The act of combination of oxygen with a base, therefore, is by no means the same with combustion. If we take a view of the different supporters, we shall find that all of them, which can be obtained artificially, are procured either from other supporters, or by the agency of electricity.

I. Oxygen gas may be procured from nitric acid and oxygenated muriatic acid, two supporters; and from several of the partial supporters—as the black oxide of manganese, the red oxides of lead and of mercury. The action of heat is always necessary; but the process is very different from combustion.

II. Air, as far as is known at present, cannot be formed artificially. The gas, indeed, which comes over during part of the usual distillation of nitrate of potash and sulphuric acid, to obtain nitrous acid, resembles air very closely: but it is obtained from a supporter.

III. The gaseous oxide of nitrogen has, hitherto, been only procured from nitrous gas and nitric acid (nitrate of ammonia), both of which are supporters.

IV. Nitrous gas can only be procured by the decomposition of nitric acid, a supporter.

V. Oxygenated muriatic acid can be formed, by combining muriatic acid with the oxygen of the black oxide of manganese, the red oxide of lead, iron, mercury; all of which are partial supporters.

VI. Nitric acid is formed spontaneously upon the surface of the earth, by processes with which we are but imperfectly acquainted; but which certainly have no resemblance to combustion. Its oxygen is, probably, furnished by the air, which is a supporter; at least, it has been ob-

served, that nitrogen and oxygen, at high temperatures, are capable of forming nitric acid.

This formation of nitric acid by means of electricity, has been considered as a combustion, but for what reason, it is not easy to say: the substance acted upon is not a combustible with a supporter, but a supporter alone. Electricity is so far from being equivalent to combustion, that it sometimes acts in a manner diametrically opposite; unburning, if we may use the expression, a substance which has already undergone combustion, and converting a product into a combustible and a supporter. Thus it decomposes water, and converts it into oxygen and hydrogen gas; therefore it must be capable of supplying the substances which the oxygen and combustible lose when they combine by combustion, and form a product.

REVIEW.

The most Expeditious Method of acquiring Accuracy and Freedom in Writing. By James Ferguson. London: printed for the Author, 23, Minories, Aldgate.

Decidedly one of the most complete writing-books we have seen. The method laid down by the author is simple and good, and cannot but be acceptable. The copy which the pupil is to follow is given in relief, so that, without the aid of a teacher, he can trace the letters with the greatest accuracy; and thus either the child or the adult can very speedily acquire a free, bold, and most agreeable style of writing.

MISCELLANEA.

Exhibition of an Immense Mastodon.—A subject of great interest to the scientific world, and to all curious in the works of nature, has been opened to the public at the Egyptian Hall, Piccadilly—namely, the skeleton of an immense animal of the extinct mastodon species, but differing from the mastodon in several respects, and is considerably larger than any animal of that description hitherto known. The skeleton is thirty-two feet in length and fifteen feet high, and has a pair of very curious circular tusks from the maxillary process. This remarkable inhabitant of a former world, which has puzzled the learned world, and for which their present nomenclature affords no name, was dug up in the Missouri by M. Coc, who, for want of a better appellation, has called it the "Missouri Leviathan."

A New Machine for Spinning and Twisting Silk, of which report speaks favourably, has been invented by a person named Henry Gref, a Swiss, Mulhausen, who is now in St. Petersburg. It is expected, that by this new machine, silk thread may be manufactured by a single operation, and without the application of spindles.—*German Paper.*

A Newly-constructed Locomotive Engine has been introduced by Mr. Stephenson; the principal alteration is that of adding three or four feet to the length of the boiler, the tubes being twelve feet in length instead of eight or nine. This will give a greater surface for heating, and is expected to be less destructive to the tubes. We have not received any particulars of its performance.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, Jan. 12, E. Cowper, Esq., Lecturer on Manufacturing Art and Machinery, King's College, on Cotton Spinning. Friday, Jan. 14, J. S. Buckingham, Esq., on Arabia. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday Jan. 13, Mrs. Foster, on the British Poets. At half-past eight.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, Jan. 11, Mr. Lanthois, on the Varieties of the Human Race. At eight o'clock.

QUERIES.

Where, or in what work, can I obtain a description of Osler's anenometer, such as that at the Polytechnic Institution? Also a description of Crosley's improved rain-guage? What is the exact weight of a cubic inch of water? W. H.

Will any of your correspondents be so kind as to furnish me with the address of Mr. Sopwith, the celebrated geologist, and a member of the Institution of Civil Engineers? S. Bowkley.

Could I make an electrical machine out of a large glass bottle; also directions for so doing? 2. How are Leyden jars coated on the inside with tinfoil? 3. How to detect nitric acid or a nitrate, in a solution supposed to contain it? 4. Is it necessary, in making an electrotype, that the inner vessel containing the dilute sulphuric acid should have any communication with the sulphate of copper; or, in other words, would a wide-mouthed bottle do for holding the sulphuric acid? 5. How to make muriate of manganese?
A. Y. C.

I shall feel obliged to any of your correspondents, if they will give a sketch and description of the best working condensing air-pump;

with a statement of what force per circular inch the air can be condensed, with the power required; and how many inches so condensed per minute. JOHN SIMS.

A simple method of letting the steam above and below the piston of a locomotive steam-engine model? R. W. BUCKLEY.

A good recipe for making the marking ink which requires no preparation? Can you refer me to any work by which I can make myself acquainted with the anatomy and physiology of gas meters? M. R. C. S.

ANSWERS TO QUERIES.

"A. M." I believe the rotary steam-engine I described, is on the same principle as Avery's; but will, if he wishes, give a description with drawings. W.

To Bronze Brass Work.—This is best done with the chemical bronze, and can be bought at Mr. Munro's, Moor Street, Seven Dials, at 9*s.* per oz. The brass must be made perfectly clean, by dipping it in aquafortis, and then washing the acid with clean water, and drying it off in sawdust. Apply the bronze with a small stiff brush; then black-lead it until it attains a high polish; it is then to be lacquered with pale or other lacquer. C. D. BAMBER.

"R. W." will find a drawing and description of a cheap hydraulic blowpipe in No. 61, vol. 2, page 167.

"G. Starkey." The best work on practical anatomy that has been published lately, is "The Anatomist's Vade Mecum," by Erasmus Wilson. This is the most elegant work on anatomy that was ever published. Mr. Starkey (who, I doubt not, is an excellent judge) will find the wood-cuts perfect gems of the art; and if he has any wish to obtain a knowledge of anatomy, I am sure he will not begrudge the half-guinea the book will cost him M. R. C. S.

"A. M." should have stated what section of mechanical practice he was acquainted with. I have to inform him, that watch-makers have constantly to turn steel, and, most frequently, tempered steel—that is, first hardened, then brightened, and let down to a blue. A graver or other turning tool, let down to a straw colour, would, therefore, to them be useless, as I could prove to him personally, if necessary. The tool must be perfectly hard, and great care must be used in hardening, that it be not left too long in the fire; as that would render it brittle. Skill, of course, is required in handling, or frequent breakage will ensue. As to its being almost impossible to bring a tool, left at its greatest hardness, to a fine edge," I can only say, from experience (perhaps more extended than that of "A. M."), that it is perfectly easy, provided a proper stove is used. Small tools, of course, require less time than larger ones: but I have found, that even tools of a moderate size are best when left hard; inasmuch as they do not get blunt so soon, and cut the work much smoother, if used with proper skill. W. H.

To Bronze Electrotype Medals.—A chemical bronze may be made by boiling two ounces of carbonate ammonia with one ounce of acetate of copper in half-a-pint of vinegar, till the latter has nearly evaporated; pour in a solution of sixty-two grains of ammonia, and fifteen grains and a half of oxalic acid in half-a-pint of vinegar. Boil the mixture; when cold, strain through filtering paper. The remaining sediment may be again treated with another half-pint of the solution. The medal must be rendered bright and clear, by means of a hard brush, rotten-stone, and water; afterwards washed, dried, and finished with a plate-leather or brush; it must then be warmed, and a camel's-hair pencil, dipped in the liquor, brushed over the surface for half-a-minute; directly after pour boiling water over it; as soon as dry, rub it lightly with soft cotton, slightly moistened in linseed oil; gentle friction, with dry cotton, will finish it. The colour is red—the tint varies.

Another Method.—Use a little weak solution of platinum, simply laid on the medal; but this requires to be varnished afterwards. Some use a very weak solution of the hydro-sulphate of ammonia or the sulphuret of potassium, which produces a sulphuret of the metal, which is of a very beautiful colour. But the simplest method is that of the application of plumbago; the bronze is obtained in a few minutes, and with very little trouble. Brush the surface with plumbago; place the subject over a fire, till too hot to be touched; apply a plate-brush as soon as it ceases to be hot enough to burn it: a few strokes will produce a dark-brown polish, approaching to black. Some subjects take the black-lead better than others. To attain the greatest perfection, the operation should be performed directly after the medal has been separated from the mould. If it be performed on one kept some days, or upon a polished surface, a different tint is obtained, which depends, in both cases, much on the surface of the original medal. Bright specimens from fusible moulds are best; but there is no occasion to clean any; the black-lead abstracted from the wax or plaster moulds, is rather an advantage than otherwise.

"J. Jenkins." Grove's battery is less adapted than any other for the electrotype, as its action seldom lasts more than an hour or two, and intensity is its chief characteristic.

TO CORRESPONDENTS.

E. S. K.—*We should have referred him to No. 30, vol. 1, instead of vol. 6.*

C. J. Masterman.—*His letter, kindly offering the loan of the work, is forwarded to "A. M."*

H. Hopkinson.—*Tradesmen to the Queen are appointed so by special warrant; but, we doubt not, that many who use the name for their proprietary articles, have no authority for so doing.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 62, THIRD SERIES. | SATURDAY, JAN. 15, 1842. | No. 310, OLD SERIES.

MECHANISM OF ORGANS.

Fig. 8.

Fig. 7.

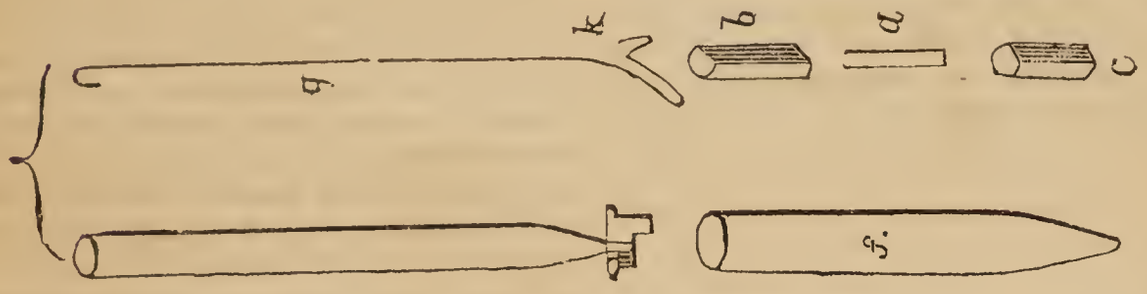


Fig. 6. Fig. 4.

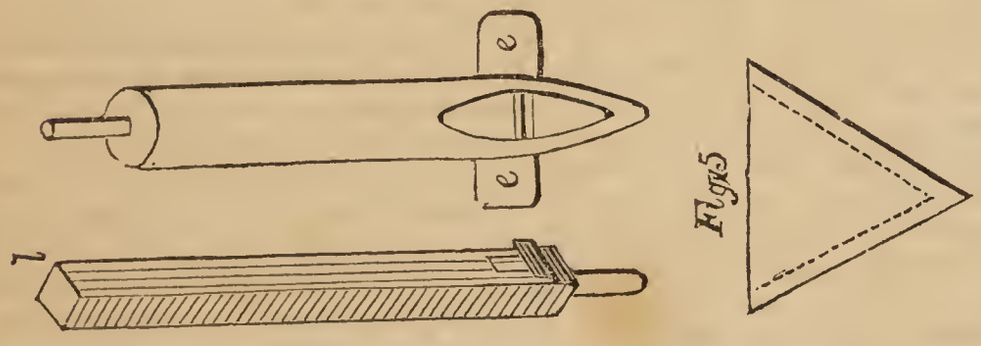


Fig. 3.

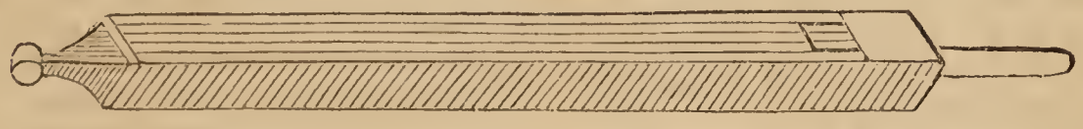


Fig. 2.

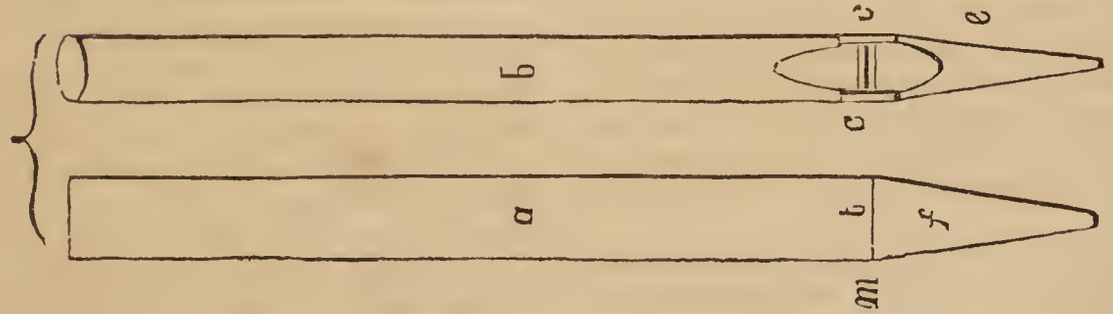
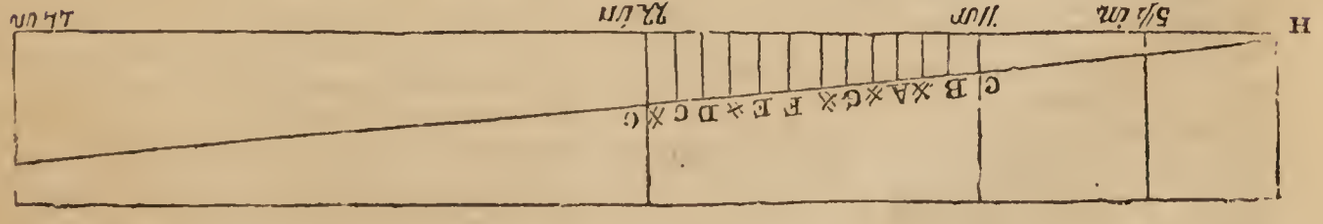


Fig. 1.



Vol. VIII.—No. 3.] [City Press, 1, Long Lane, Aldersgate Street: D A. Doudney.

MECHANISM OF ORGANS.

(Continued from page 418.)

ORGAN PIPES.

HAVING given an explanation of the mechanism of the internal parts of an organ, the next thing required, is an account of the different kinds of pipes, and the method of making them.

In the first place, it is necessary to construct a scale to make them by, which can be done in the following manner. Take a thin flat piece of deal, about eight feet long, and six or seven inches wide; plane it smooth, and cover it with white paper, glued or pasted on, and cut one edge perfectly straight; then measure off eleven inches from one end, and mark the place; also make another mark at twenty-two inches from the same end; then place a square at each mark, and draw a line across the board at each place; measure off a part nine-tenths of an inch from the mark at twenty-two inches, and draw a line, *c c*, between the two, fig. 1. This line is to be continued to the ends of the board. Perpendicular lines may now be drawn at five inches and a half, and eighty-eight inches from the same end, as before. The parts between each perpendicular line are now to be divided, each part into twelve, and marked, as in the figure: one part only is divided to prevent confusion. This forms the scale. To make any particular pipe, you have only to look for its place on the scale, and measure the length from H, and the length of the perpendicular line. For example, take the middle C; its distance from H is twenty-two inches, and this is the length of the pipe. The length of the perpendicular line is one inch and a half: this is the diameter of the pipe.

As a general rule, let it be remembered that, having the size of one pipe, its octave below is always double the length, and its diameter two-thirds more. For the octave above, it is half the length, and its diameter two-fifths less. Of course you can carry your scale to any length you please.

I should also mention, that different kinds of pipes are made on different scales—that is, having a different diameter compared with their length; and, be it always remembered, that the greater diameter, the less length is required to produce the same note. A scale is said to be larger or smaller, according to the diameter of the pipes, without reference to their length; and, lastly, the larger the scale, the more powerful the sound of the pipes.

Organ pipes are made, some of metal and some of wood. The metal is a mixture of lead and tin, or lead and antimony, or lead, tin, and antimony.

I am told by a first rate organ builder (perhaps the first in London), that the best metal is old type-metal, as the mixture is already carefully made, and it has the required hardness. The solder should be made of grain tin, and some of the alloy of which the pipes are made. The metal is first cast into sheets, then planed smooth, and cut to the size required for the pipe intended to be made; the edges are then covered with size and whitening, and just where the joint is to be, it is scraped off. It is then soldered with the usual soldering iron.

A pipe is composed of three parts—viz. the effective part—that is, the part from the mouth upwards—the tongue, and the foot. In speaking of the length of a pipe, the length of the effective part only is named; as the length of the foot is of no consequence, it being merely to convey the wind, and to support the pipe in the rack-board. Fig. 1, *a*, is the section of a pipe, and *b* a front view; *a*. the effective part; *t*, the tongue; *m*, the mouth; and *f*, the foot. *c c*, the cheeks, are little pieces placed at the side of the mouth. The pipe is a little flattened at the mouth; also the foot; and the tongue is nicked, or serrated with fine teeth.

The wooden pipes are made of pine, with hard wood for blocks and caps.

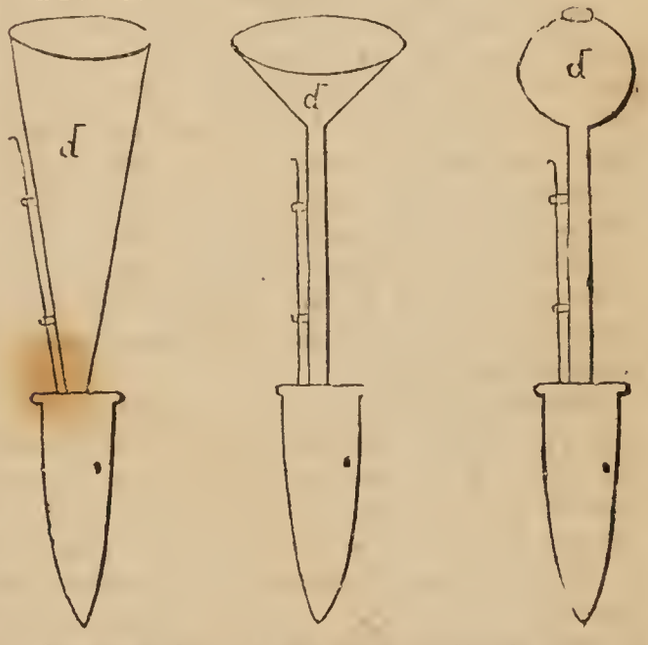
Of the different kinds of Pipes.

The stop of most consequence in an organ, is the *principal*, as all the others are tuned from it. The form is that of fig. 2, and the scale is that described previously. The next is the *open diapason*; this is of the same form as the principal, but made on a larger scale; also, the octave below is placed on the same groove as the octave of the principal. The next stop is the *fifteenth*; this is still of the same form, but on a smaller scale than the principal, and the octave above the principal is placed on the same groove with it. The *twelfth* is of the same form and scale as the fifteenth, but the third below the fifteenth, and is placed on the same groove. To explain more clearly, suppose we touch the key, middle C, having the four above-named stops open; the note sounded in the principal, is an octave above that sounded in the open diapason; the fifteenth, an octave above the principal, and the twelfth a third below the fifteenth. The *dulciana* is still of the same form, but on a very much smaller scale; and the

pitch is the same as the open diapason, but the tone is as different as can well be imagined; it is excessively soft and sweet, which gives rise to the name. The *stopt diapason*, fig. 3, is a wooden pipe, of course square. The mouth is made with a block or plug, similar to the flageolet; only that it is square instead of round, and nicked, as the other pipes. It has also a plug at the other end, and is of the same pitch as the open diapason, though only half the length; all stopt pipes being an octave below open ones of the same length. The sound is very peculiar, being like that heard on striking an empty barrel; it is extremely rich and full, and can be heard at a great distance, though it does not appear loud when close to it. The *double diapason* is similar, only on a larger scale, and an octave below the diapasons. These pipes are played by the feet, being pressed on pedals. The metal pipes are tuned by cutting them down shorter, until very near the tone required, and the pressing out the top or pressing it in, by a hollow cone of brass. A section is seen at fig. 5. Opening the top, by pressing in the cone, sharpens the tone; and closing it, by putting the top of the pipe in the hollow of the cone and pressing it, flattens the tone. The stopt pipes are tuned by the plugs at the end: when pushed in, the tone is sharper, and *vice versâ*. The *open flute* is a wooden pipe, fig. 4, open at top, but with a small piece of metal, like the lid of a box partly closed, *l*; this is to tune it; of course, the tone being flatter the more it is closed. The *stopt flute* is like the stopt diapason, but on a smaller scale, and the same pitch as a flute; also the open flute. The *metal flute* stop is like the principal, stopt at the end, with a small chimney to it, fig. 6, and very long ears, *e e*, by which it is tuned. The *sesquialtera* is a stop in which there are two, three, or four pipes (of the same form as the principal) to every key; and placed so that, by touching any key, it will sound the common chord of the key held down.

Quite another description of pipes are the *reed* pipes. In them the sound is produced by the vibration of a metal tongue against a piece of tubing, stopt at one end, and having a piece cut off one side, fig. 7; *a*, the tongue; *b*, the tubing, having the lower end cut in a slanting direction, and stopt with another piece of brass, and the left side sliced off; *c*, the reed—that is, the tongue and tube together; *d*, the pipe, having a solid piece, *e*, at the bottom, made with a shoulder, and of a size to fit, air-tight, into the foot, *f*, in which there is a small hole, marked by a black dot, to let part of the wind escape, as these pipes require to be blown gently. The part, *e*, has a hole communicating with the pipe above (shown by the dotted lines), into which the reed is introduced, and fixed there by a very small wedge of wood. There is also another hole in *e*, marked by a black line; this is to admit the wire-spring, *g*, the upper part of which goes into the loops, *h h*, on the pipe. This spring has a cross piece, *k*, which presses against the tongue of the reed, and is for the purpose of tuning; as, by moving it up or down, it alters the effective length of the tongue. Fig. 8 is the whole put together. This is one of the pipes in the Cremona stop; its pitch is the same as the diapasons. The tone is very soft and sweet, and it is usually placed in the swell-box. All reed pipes are of the same form as the above, as far as regards the parts for the production of the sound; but the tone is varied by the shape of the pipe, *d*. Fig 9, the trumpet stop: fig. 10, the haut-boy stop; fig. 11, the vox humana, &c.

Fig. 9. Fig. 10. Fig. 11.



It is, perhaps, the most difficult part of organ building, to *voice* the reed pipes; as the least moisture, the most trifling imperfection in the manufacture—a little dust, or even a hair, introduced by accident into the reed, will prevent its speaking. Nothing but long-continued practice can enable a person to put together the parts of a reed pipe, so as to make it speak; and it is one man's business to make the reeds only.

Though there are several other kinds of stops, I have here enumerated all the principal ones; and even all these are only found in the largest church-organs. Of course it would be impossible, in the space that can be spared in the pages of a

Magazine, to enter more into the minutiæ, nor would it be of any interest to the general reader.

G. S., Jun.

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS, &c.

(Continued from page 12.)

As different degrees of heat remove different degrees of condensation received from the hammer, and a white heat removes all, it is of great importance to harden steel from the lowest possible degree of heat, in order to retain as much condensation as practicable; and it is a fortunate coincidence, that the greater the condensation, the lower is the heat from which steel will harden, and the stronger and tougher it will be. But should this condensed metal be once over-heated, it will no longer harden from that lower degree, but only from a heat nearly approaching that to which it was originally raised; in this case the condensation, with all its attendant advantages, can only be restored by rehammering.

The lowest heat at which steel will generally harden, is a dull or cherry-red, just visible in day-light; therefore, to be safe, the same test—i. e. a dull-red heat, only perceptible in the dark, is chosen for the process of hammering: it offers, too, the advantage of coating the article with carbonaceous matter,* thereby securing, instead of losing, by the action of the fire, a due supply of carbon, which is of particular consequence.

Different modes of performing this very important part of the process may be adopted; it is essential that the forge should not be under the influence of a strong light; the anvil should be placed, as near as circumstances will permit, to the flat bed of the forge, and the fire, smothered with small fuel, just kept alive by the bellows, so as never to allow the gas to burst into flame. The pieces of steel under treatment, are now placed in the smouldering and partially kindled fuel, enveloped in smoke, whence they imbibe a portion of carbon, which the hammering heat is insufficient to expel. They are then brought in succession from the fire to the anvil, and back again to the fire, when too cool. The hammer is moved quickly, and every part of the steel subjected to its blow. The position of the article is then slightly changed, and the operation continued till it has been well hammered in every direction, being repeated as often as needful. Experience will soon teach the workman the art of discerning, both by the sound of the blow, and the feel consequent to the decreased effect produced by the hammer, when the proposed end is attained, and the steel sufficiently condensed.

Although, at this comparatively low heat, the metal spreads much less than it does under the influence of a higher temperature, we must remember that, unless it be confined in proper recesses or moulds, the expansion produced by the inner acting on the outer portion, is so considerable, as to render the exterior hard worthless.

From what has been stated, it is clear that there are two principal causes for the failure of steel, more particularly if used quite hard. The first is an unequal combination of carbon with the iron; and this is more or less the case with all steel, till properly hammered. The toughness of some parts, the brittleness of others, and the different states of tension hence arising, cause the metal to be liable to crack—if not in the hardening, yet subsequently, when under the pressure of a severe strain, or the accumulating force of a descending blow. The second cause is bad or imperfect hammering; for I think I have demonstrated that, however much hammered, steel may be, and often is, left by the workman in a violently conflicting condition; some parts girded and compressed, whilst others are as much strained, almost to breaking.*

Steel, well and duly hammered, requires

* Mr. Stodart relates a singular confirmation of this fact, although he does not seem to attach much value to peculiarities in the process of hardening; he mentions it as the observation and practice of one of his workmen, that the charcoal fire should be made up with shavings of leather; and, upon being asked what good he supposed the leather could do, this workman replied, that he could take upon himself to say, that he had never had a razor crack in the hardening since he had used this method, though it was a very common accident before.—*Martin's Circle of the Mechanical Arts*, p. 261.

* I fancy, the advantage derived from the act of repeated hammering, is partially known to some workmen; as I recollect showing a 2¼ inch round bar of cast steel, manufactured by Mr. Stubbs, of Warrington), to an excellent machinist, whose opinion I wished to have, as to the best mode of converting the said bar into a lathe mandrel; his advice was to turn it down to the proper form and size, but by no means to forge it out. His words were, "If well hammered nearly cold, the metal will be much improved; but, if forged, it certainly will be injured, and may be totally spoiled."

the least tempering to produce the necessary degree of toughness; but, when hardened at too great a heat, it loses all the previous condensation from the hammer, and with it so much strength, that the tenacity disappears, and the same hardness, with less strength, shows itself in brittleness. Steel, therefore, thus incautiously treated, requires more letting down by tempering, to obtain a practical degree of toughness. Such tools are too weak and soft for turning steel or iron, and do not stand long for any purpose.

It seems feasible to imagine, that there is a given degree of cold to which steel must be brought in a given time, to cause hardness; also a given degree below which it will not harden; and that any farther increase of heat only serves to weaken the metal, as, likewise, any farther increase of cold tends only to harden a greater mass, or a deeper coat of a large mass, by cooling it in the required time. Steel, much over-charged with carbon, is too harsh or brittle to receive all the improvement that hammering would otherwise impart; but, by selecting the most malleable steel, of sound quality, and hammering it at a heat so low as to be capable of retaining a coat of carbonaceous matter, it will imbibe the carbon so slowly, and in such minute quantities during each hammering, as to enable the workman to enforce the fullest charge compatible with sound hammering. To this limit carbon must improve the strength; but beyond it, brittleness comes on, and it refuses to receive any condensation from the hammer, by which alone, toughness is given. It is, obviously, useless to endeavour to obtain hardness, if unaccompanied by toughness, as we should be obliged to let it down to avoid breaking; yet many suppose the hardness to be increased by coming up to this brittleness: therefore taps, dies, and turning tools, in order to combine extreme hardness with toughness, are allowed to imbibe a little more carbon on their surface, by placing them in red-hot carbonaceous matter for the hardening—the tenacity of the interior metal remaining unaltered. For this purpose animal charcoal is generally used; burnt leather answers the object, and appears to impart the carbon much quicker than wood charcoal. In all cases of hardening, it is advisable to heat the steel in air-tight vessels of some sort, to protect it from the action of the atmosphere, and prevent the carbon burning out of the surface. Water has a slightly injurious effect on the exterior of steel, at the moment of immersion. To prevent this, small articles are frequently plunged in oil or tallow, which has the reverse tendency. Files, and some tools that do not admit of being sharpened, are left quite hard; but, in all other cases, to avoid the risk of breaking, the extreme hardness is removed by tempering, more or less, as the nature of the work for which the tool is intended will allow.

(To be continued.)

BIOGRAPHICAL NOTICES.

No. VI.

ALBERT DE HALLER, M. D.

Albert de Haller, an eminent philosopher and physician, was born at Bern, on the 16th of October, 1708. He was the son of an advocate of considerable eminence in his profession. His father had a numerous family, and Albert was the youngest of five sons. From the first period of his education, he showed a very great genius for literature of every kind. To forward the progress of his studies, his father took into his family a private tutor, named Abraham Billodz; and such was the discipline exerted by this pedagogue, that the accidental sight of him at any future period of life, excited in Haller very great uneasiness, and renewed all his former terrors. According to the accounts which are given us, the progress of Haller's studies at the earliest periods of life was rapid, almost beyond belief. When other children were beginning only to read, he was studying Bayle and Moreri; and at nine years of age he was able to translate Greek, and was beginning the study of Hebrew. Not long after this, however, the course of his education was somewhat interrupted by the death of his father; an event which happened when he was in the thirteenth year of his age. After this, he was sent to the public school at Bern, where he exhibited many specimens of early and uncommon genius. He was distinguished for his knowledge in the Greek and Latin languages; but he was chiefly remarkable for his poetical genius; and his essays of this kind, which were published in the German language, were read and admired throughout the whole empire. In the sixteenth year of his age, he began the study of medicine at Tubingent, under those eminent teachers, Duvernoy and Camerarius; and continued there for the space of two years, when the great reputation of the justly celebrated Boerhaave drew him to Leyden. Nor was this distinguished teacher the only man from whose superior abilities

he had there an opportunity of profiting. Ruysh was still alive, and Albinus was rising into fame. Animated by such examples, he spent all the day, and the greatest part of the night, in the most intense study; and the proficiency which he made, gained him universal esteem from both his teachers and fellow-students. From Holland, in the year 1727, he came to England. Here, however, his stay was but short; and it was rather his intention to visit the illustrious men of that period, than to prosecute his studies at London. He formed connexions with some of the most eminent of them. He was honoured with the friendship of Douglas and Cheselden; and he met with a reception proportioned to his merits, from Sir Hans Sloane, President of the Royal Society. After his visit to Britain, he went to France, and then, under those eminent masters, Winslow and Le Dran—with the latter of whom he resided during his stay at Paris, he had opportunities of prosecuting anatomy, which he had not before enjoyed. But the zeal of our young anatomist was greater than the prejudices of the people at that period, even in the enlightened city of Paris, could admit of. An information being lodged against him to the police, for dissecting dead bodies, he was obliged to cut short his anatomical investigations by a speedy retreat. Still, however, intent on the farther prosecution of his studies, he went to Basle, when he became a pupil under the celebrated Bernoulli.

Thus improved and instructed by the lectures of the most distinguished teachers of that period, by uncommon natural abilities, and by unremitting industry, he returned to the place of his nativity, in the twenty-sixth year of his age. Not long after this, he offered himself a candidate, first for the office of physician to an hospital, and afterwards for a professorship But neither the character which he had before, he left his native country, nor the fame which he had acquired and supported while abroad, were sufficient to combat the interest opposed to him. He was disappointed in both; and it was even with difficulty that he obtained, in the following year, the appointment of keeper of a public library at Bern. The exercise of this office was, indeed, by no means suited to his great abilities; but it was agreeable to him, as it afforded him an opportunity for that extensive reading, by which he has been so justly distinguished The neglect of his merit which marked his first outset, neither diminished his ardour at home, or abroad; and, soon after, he was nominated a professor in the University of Gottingen, by King George II. The duties of this important office he discharged with no less honour to himself than advantage to the public, for the space of seventeen years; and it afforded him an ample field for the exertion of those great talents which he possessed. Extensively acquainted with the sentiments of others, respecting the economy of the human body—struck with the diversity of opinions which they held, and sensible that the only means of investigating truth was by careful and candid experiment, he undertook the arduous task of exploring the phenomena of human nature from the original source. In these pursuits he was no less industrious than successful; and there was hardly any function of the body on which his experiments did not reflect either a new or stronger light. Nor was it less necessary for him, in this arduous undertaking, to labour alone. The examples of the preceptor inspired his pupils with the spirit of industrious exertion. Zinn, Zimmerman, Caldani, and many others, animated by a generous emulation, laboured, with indefatigable industry, to prosecute and to perfect the discoveries of their great master; and the mutual exertion of the teacher and his students, not only tended to forward the progress of medical science, but placed the philosophy of the human body on a more sure, and an almost entirely new, basis.

(To be continued.)

THE GREAT WESTERN RAILWAY ACCIDENT.

To the Editor of the Penny Mechanic and Chemist.

SIR,—It is much to be regretted, that there are found a class of individuals who judge of things according to their own feelings, unguided by simple truth. They do not choose to take the trouble to inquire the "why" and "wherefore" of a subject, but form their judgments on the spot, and give them forth, right or wrong.

Your correspondent "A." is, I fear, one of this class. From some cause or other, he is too late for the Great Western mail-train, is obliged to travel by the luggage-train, and thus (doubtless, in no very good humour with things around him) commences his journey. The first complaint is of want of comfort in the luggage-train. Whoever supposed that those who pay the smaller amount, should be accommodated so well as those who pay the full fare? If "A." thinks so, he must be very unreasonable. He then discovers (in the dark)

that the speed is not more than eight miles per hour in some places, and thirty-five in others. At the latter speed he expected to be run off the line and dashed to atoms! It was well for his nerves that he was too late for the mail-train. He evidently has not had much experience in railway travelling, to be alarmed at this rate of speed, which is the average maximum on almost all the lines; while, on the Great Western, in consequence of the superior width of gauge, forty-five miles is the average, and frequently it rises to fifty per hour. As to the difference of speed, by "A.'s" own showing in the latter part of his letter, the load varied much; there are, also, inclines to be ascended, which cause, of course, a retardation, and, when descended, an acceleration. But as to the amount of variation, "A." must excuse me if I doubt his ability to judge in the dark.

"Misfortunes never come singly;" an adage which poor "A." verified on that night of mishaps. He begins badly by being too late, and goes on no better. He gets detained at Chippenham, because, as he states, the luggage-train was not sufficiently noble to demand the attention of the workmen; and it must wait till its more important successor arrives, before they would deign to let it pass. Now, sir, the version of the story, I strongly suspect, should be this:—some obstruction on the line of way existed, which must be removed before the train could pass safely; and, therefore, "A." was detained. The other view of the case is absurd, as it would cause scarce a moment's cessation from work, to allow the luggage-train to pass at its proper time. As to the arrangements respecting tickets, I can only say from experience, that the servants of the Company offer every facility in such matters; and, perhaps, if we were to hear the opposite side of the question, that matter, too, would appear different.

"A.," in conclusion, gives vent to his spleen, by blaming the Company for the late sad accident, attributing it to the position of the passenger carriages in the train. How is it, then, that the engineer and stoker were not injured, although the first in the danger? The carriages behind a luggage-train are those most liable to injury, because of the slower rate of travelling, being liable to be run into by quick trains overtaking them. If the passenger-trucks had been in the middle of the train, they would have been thrown off, because of their lightness—the weight of the luggage-vans keeping them from falling over. From the evidence on the inquest, it seems that the accident was one of those unforeseen occurrences which no human foresight could have avoided. The slip appeared, from after examination, to have been actually taking place just before the train came up. A large stone, two feet square, first threw off the engine. The bank near the spot had been observed to slip, superficially, some weeks previously; had been repaired and duly watched, till all farther danger was thought to be passed, and the watching was then discontinued.

Railways have a most unfair prejudice exercised against them by some persons. Every accident that happens, is at once set down to carelessness, or something more, as though they were not to be subject to accidents as well as everything else. Charges of negligence should not be lightly brought against any; as the bare idea of having been the cause of mischief—such as the loss of life—must press very heavy on every mind of right feeling. Sad, very sad, the accident has been; but let us not blame without strong, very strong, cause for it.

I may observe, in conclusion, that a very effective plan to prevent mischief by collision has been proposed—viz. the introduction, before and behind each train, of some efficient buffing apparatus, that would effectually, by its elasticity, prevent a sudden shock. There is, also, a plan much followed in America for preventing slips in embankments or cuttings—viz. driving piles, ten feet long, into the surface.

I should not have noticed your correspondent's letter, but for its appearance in a Journal, from the pages of which I have derived much pleasure, and to the subject-matter of which I am in the habit of occasionally contributing.

I remain yours, &c.,

W. H.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, Jan. 19, E. Cowper, Esq., Lecturer on Manufacturing Art and Machinery, King's College, on Cotton Spinning. Friday, Jan. 21, J. S. Buckingham, Esq., on Arabia. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Wednesday, January 19, Quarterly General Meeting. At half-past eight.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, Jan. 18, Mr. J. Townley, on Modern Geological Researches. At eight o'clock.

QUERIES.

I should feel greatly obliged if "T. Fuller, jun.," or any of your valuable correspondents, would give a full description of the manufacture of plain and cut glass in all its branches, in an early Number. W. D.

How to remove hair effectually from the skin without injury, attainable by any person not understanding chemical preparations? S. S.

1. How to make blue ink from indigo, without sulphuric acid? 2. The best method of painting diagrams on glass for a magic lantern? 3. How to make a portable camera obscura, and every particular respecting the lens? 4. The reason coal burns better when wet, than when dry?
W. H. V.

The cheapest place to buy the apparatus for the electrotype engraving; and whether the zinc must be entirely covered in the acid? Also, how they are to be bronzed? A. B. C.

1. How to make a twelve-inch globe of pasteboard? 2. How are globes coloured white, and what kind of varnish is used? Also what kind of ink is the most suitable for drawing maps? 3. How to find the parallax and distance of a planet, with diagrams? 4. How to make a planisphere? E. L.

In what manner, and of what materials, must I manufacture a web of so delicate a texture, that when it comes in contact with the human frame, it immediately flies off, on account of the perspiration or heat emanating from the body? Whose is the best work on practical geometry, and elocution? How is it that a beech-tree is a non-conductor of the electric fluid? The simplest method of proving the purity of gold, without any chemical process. The specific gravity of nickel?
J. J. Brooks.

ANSWERS TO QUERIES.

"W. H." I have a small handsome brass model of a steam-engine; cylinder, 1 inch diameter; stroke 1½ inch long; complete, with eccentric, side valve, parallel motion, two brass flywheels, &c., on a mahogany stand; also a cylindrical copper boiler, 10½ inches long, and 5½ inches diameter, with spherical ends complete, with safety-valve, cocks connecting pipe to engine, &c.; together with an iron furnace for ditto, and chimney complete, and painted as a brick stack; the boiler is bright. The above is nicely got up, and will be sold cheap. C. H.
Post-office, Cirencester.

To Stain Beech a Mahogany Colour.—Take 2 oz. of dragon's blood, break it in pieces, and put it in a quart of rectified spirits of wine; let the bottle stand in a warm place, shake it frequently, and, when dissolved, it is fit for use.

To Stain Boxwood Brown.—Hold your work to the fire, that it may receive a gentle warmth; then take aquafortis, and with a feather rub over the wood till you find it change to a fine brown; always keep it near the fire; then oil and polish it.

To Stain Wood Black.—Have a copper fixed, or an iron pot, into which put 6 lbs. of chip logwood, and as much wood or veneers as it will conveniently hold, without pressing tight; then fill with water, and let it boil slowly for about three hours; then add ¼ lb. of powdered verdigris, ¼ lb. of copperas, and 2 oz. of bruised nutgalls, filling the copper up with vinegar as the water evaporates; let it gently boil two hours a-day, till you find the wood to be dyed through, which, according to the kind, will be in more or less time.

To Dye Wood Yellow.—Take 2 lbs. of the root of barberry, reduce it, by sawing, to dust, which put in a copper or brass trough; add 2 oz. of turpentine, to which put two gallons of water; then put in as many veneers as the colour will cover; boil them for three hours, often turning them. When cold, add 2 oz. of aquafortis, and you will find the dye strike through much stronger. White holly is the best wood for this colour.

To Dye Wood a Bright Green.—Proceed as before to dye a yellow; but instead of aquafortis, put as much of the vitriolated indigo as will produce the desired colour.

To Dye a Fine Purple.—Take 2 lbs. of chip logwood, ½ lb. of Brazil dust, and four gallons of water; put in your veneers and boil them well; then add 6 oz. of pearlash and alum. Let them boil two or three hours every day, till you find the liquor has struck through. P. T.

To Dye Wood a Fine Blue.—Take a clean glass bottle, into which put 1 lb. of oil of vitriol; then take 2 oz. of the best indigo, pounded in a mortar into small lumps; put them into the vitriol; take care to set the bottle in a basin or glazed earthen pan, as it will ferment. After it is quite dissolved, provide an earthen vessel, so constructed, that it will conveniently hold the wood you mean to dye; fill it one-third with water, into which pour as much of the vitriol and indigo, stirring it about till you find the whole to be a fine blue dye, by trying it with a piece of white paper or wool. Put in your wood or veneers, and let them remain till the dye has struck through.

To make Windsor Soap.—Slice the best white soap as thin as possible; melt it in a stew pan over a slow fire; scent it with oil of carraway or any other scent, and then pour it into a mould made for that purpose. When it has stood for three or four days in a dry situation, cut it into square pieces, and it is fit for use. P. T.

TO CORRESPONDENTS.

James Ayton, Norwich.—*We should be sorry to trust ourselves on a velocipede constructed according to his principle. He had better make a trial of it himself, which will give him a better idea of the objections to it than we can describe.*

J. D.—*A book containing prices of chemicals, &c., is published by Palmer, 103, Newgate Street.*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

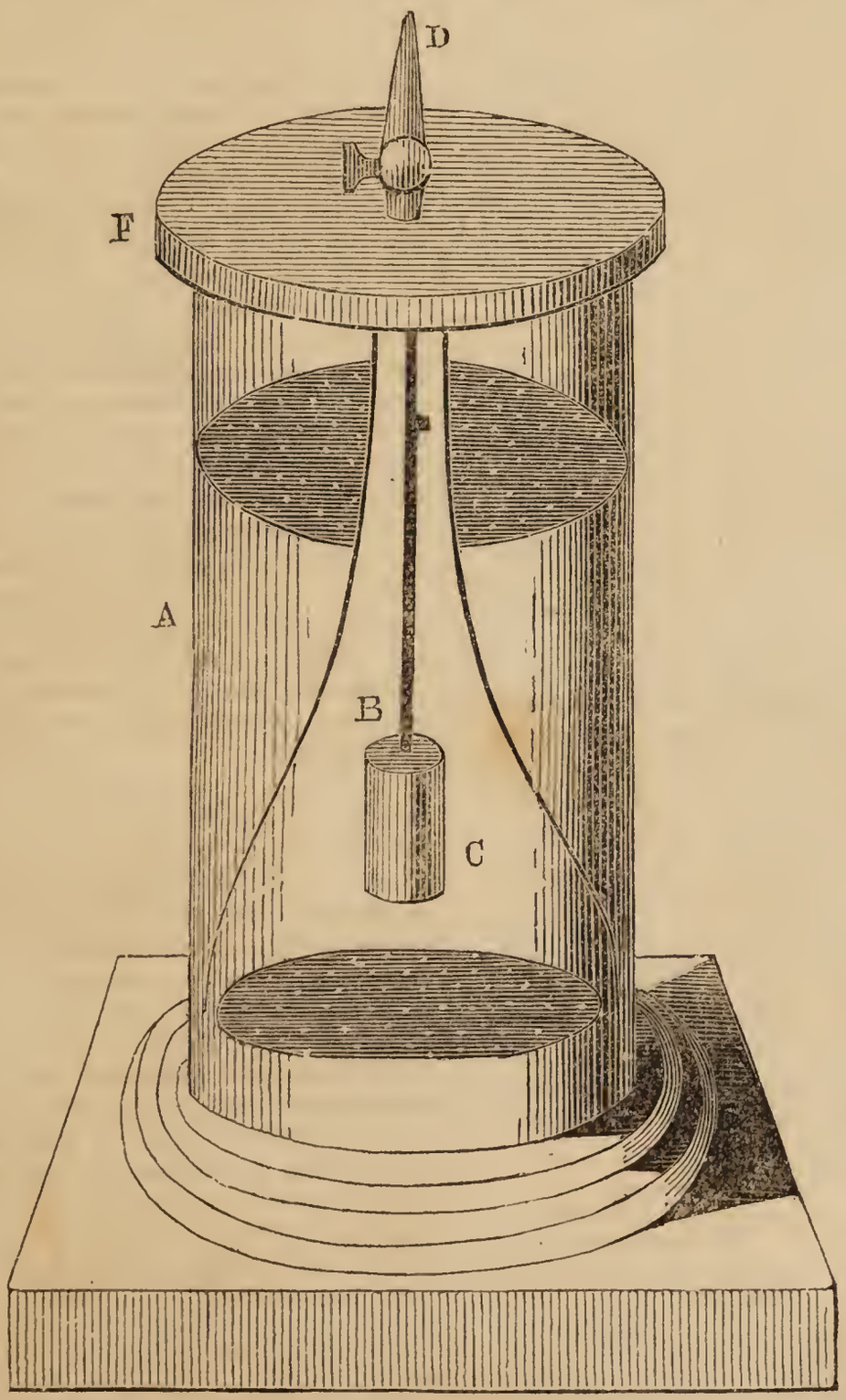
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 63, THIRD SERIES. | SATURDAY, JAN. 22, 1842. | No. 311, OLD SERIES.

STARKEY'S HYDRO-PNEUMATIC LAMP.



Vol. VIII.—No. 4.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

STARKEY'S HYDRO-PNEUMATIC LAMP.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

SIR,—Hydrogen having the property of causing spongy platinum to become red hot, and then becoming inflamed by it, has given rise to the following instrument, —the hydro-pneumatic lamp.

Description of the Engraving.

A represents a cylindrical glass vessel; B, a smaller glass, cemented to the moveable cap, F; C, a roll of zinc, attached to the cap by a slip of lead; D is a stop-cock, to charge this instrument with hydrogen. The vessel, A, must be nearly filled with water, previously mixed with one-eighth the quantity of sulphuric acid; hydrogen will then be generated, and a quantity occupy the part of B, not filled with water; here, acting with a pressure upon the water, the latter is driven into the outer cylinder, A; and, by this means, the zinc is left bare, and no more hydrogen is formed. To procure a light, turn the stop-cock, D, and the hydrogen will pass out in a very minute stream; by holding over it a ball of spongy platinum, it will become red hot, and the hydrogen jet be inflamed. As the gas burns, the pressure in B is removed; the water again sinks, acts upon the zinc, and forms gas a second time, and so on till the whole is consumed. In the drawing, the stop-cock is vertical; but they are generally made with a side jet, to permit the gas to strike against a platinum ball placed by the side of it.

As a test to detect arsenic, it will be found, likewise, extremely useful: by placing the suspected article (either in solution or otherwise) into the vessel, A, with the sulphuric acid and water, the gas will be generated, which will be pure hydrogen; if no arsenic had been present, on the contrary, arseniretted hydrogen; which may be known by holding a piece of glass or talc over the flame; the arsenic being deposited, in the metallic state, on it.

I remain yours, &c.

G. STARKEY,
Mineralogical Chemist.

Metropolitan Improvements.—The Commissioners of Woods and Forests have given orders to their architects and surveyors, to commence the projected improvements at the West End, at Lady Day. The line of the intended new street will be commenced in Castle Street, Long Acre, where the houses will be first pulled down.—*Times.*

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS, &c.

(Continued from page 21.)

VARIOUS methods have been introduced, in order to measure the exact degree of temperature, particularly in respect of long and thin articles, which are difficult to heat uniformly. Before I proceed, however, I beg to direct the attention of mechanics to the vicious and most defective process of hardening direct from the anvil, still practised at Sheffield, and, as I am informed, generally throughout the manufacturing districts. It must, I apprehend, be sufficiently obvious to any person who will take the trouble to disabuse his mind of an old custom, which has nothing but antiquity to recommend it, that steel, hardened with the scale adherent to its surface, must naturally receive a very imperfect impression either of heat or cold; because this scale, which is produced by the act of forging, varies in thickness, according to the degree of heat employed in forging: it is also a bad conductor of heat; consequently, the sudden transition from heat to cold, on which the success of the process depends, is not uniform in respect of time; the results of which are shown by one piece of steel being hard, while another is scarcely hardened at all. owing to the resistance presented by the scale to the cold temperature of the water. Hence, when such articles are subsequently *drawn down*, scarcely any two out of a large number, will be found alike in temper; a fact which can scarcely have escaped the observation of any one in the habit of using edge-tools.

As a means of avoiding this slovenly and very imperfect mode of hardening, all that is requisite is, to pass the material from the anvil to the grindstone, a slight application of which will remove the whole of the scale or coating, and render the steel fit for the operation of hardening with that accuracy, which cannot otherwise be obtained; for it is undoubted that steel, thus cleansed, heats in the fire with great regularity, and is equally sensible to the immediate action of the water on its body when immersed, so as to receive a similar degree of hardness from one extremity to the other. To this may be added, that, as the lowest possible heat* at

* The best rule is, to harden as little as possible above the state intended to be produced by tempering.—*Martin's Circle of the Mechanical Arts*, p. 261. As cast steel, annealed to a straw colour, is softened nearly as much as other kinds to a purple or blue, the workman may avail himself of this peculiar property, in tools, made of cast steel, and intended to sustain a good edge, for cutting

which steel becomes hard, is indubitably the best for all practical purposes, the mode here described† will be found to be the only one by which the process of hardening can be effected with less heat than is or can be required in any other way.

To return to the different methods that have been recommended for obtaining a perfectly uniform temperature in hardening, as well as tempering, articles of delicate construction. Melted metal, the fusing point of which is just under the right temperature, has been used; and if the mercury or other melted metal be in sufficient quantity, and the heat be measured by a thermometer, it will insure accuracy. We are indebted to Mr. Nicholson for a simple, yet effectual plan, by which the difficulty experienced in communicating to some articles a uniform degree of heat in an ordinary fire, is entirely obviated. Mr. Nicholson employed a bath of melted lead—that is, fine lead, containing little or no tin, ignited to moderate redness, and well stirred; into this the steel is plunged for a few seconds, until, when brought near to the surface, that part did not appear less luminous than the rest; the piece is then quickly stirred in the bath, suddenly drawn out, and plunged into a large body of water. In this manner, a plate of steel may be hardened, so as to be perfectly brittle, and yet continue so sound, as to ring like a bell; "an effect," observes Mr. Nicholson, "which I could never produce in any other way."

In the year 1789, Mr. David Hartley obtained letters patent for a mode of tempering instruments of hardened steel, which, unlike most other patents, has stood the test of time, and is, we believe, universally approved by men of scientific attainments. Mr. Hartley's plan was, to immerse the articles in a bath of oil, heated to a regulated temperature, and measured by a thermometer. This is, unquestionably a great improvement, both in point of precision and despatch, on the common method of ascertaining the temper by the colour, which we shall describe presently. The method of tempering by oil is found exceedingly convenient; as any number of articles, however irregular their shape, may be operated on at one and the same time. It is merely requisite to put them in a suitable vessel, with as much oil or tallow as will cover them; the vessel is then placed on the fire, and the temper ascertained by the following circumstances:—When the tallow is first observed to smoke, it indicates the same temper as that called a straw colour; when the smoke becomes more abundant, and of a darker colour, it will be equal to a golden brown; if the tallow be heated, so as to yield black smoke, and in a plentiful quantity, this will denote a temper equivalent to purple. The next degree of heat is known by the tallow taking fire, if a lighted body be presented to it, yet not so hot as to continue to burn when the light is withdrawn; and this will denote a blue. If the whole of the tallow be allowed to burn away, or burn dry (to use the technical expression), it imparts the temper generally selected by clockmakers for their work. A farther supply of tallow would be useless, as a very trifling degree of heat beyond this point, would just be visible in a dark place, which is equivalent to the lowest grade of red heat.

It is evident, that a bath of any of the soft metals, whose fusible points are just above that required for tempering, may be used instead of oil; and alloys of those metals might be so proportioned, as to obtain points of fusion at the exact degree of heat required. In these cases, however, to guard against oxidation, it would be absolutely necessary to keep the fluid metal covered with grease; and it would be advisable not to omit the use of the thermometer.

Two modes of tempering hardened steel are in common practice: the first is termed *blazing*; the article is smeared with tallow or oil, and held over the fire till the smoke rises copiously; this is supposed to indicate a temper equivalent to 450° Fahrenheit. A still lower temper is given when the oil catches fire; and from this the process is supposed to take its distinctive appellation, "blazing off." This mode of lowering or drawing down, is, manifestly, very indefinite and defective; as it affords no means of judging of the effect produced by certain degrees of heat on hard steel of different and varying quality; yet it is very extensively applied, and, in some cases of hardware manufacture, to the exclusion of every other: perhaps after all, particularly for articles of any substance, *colour* offers the simplest and most direct criterion; and, since it is ascertained that

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iron and other metals, which will not require *letting down*, provided the ignition be carefully regulated in the first instance, as the most useful hardness is produced by that degree of heat which is just sufficient to effect the purpose.—*Smith's Panorama of Science and Art*, vol. i., page 6.

† Hebert's "Engineers' and Mechanics' Encyclopædia," vol. i., p. 4

the letting-down or tempering of hard steel, is absolutely essential for the production of a fine and durable edge, I shall here take occasion to lay before the reader, the results of Mr. Stodart's experiments on the subject, as the mode of estimating the effect by the film of oxide or colour exhibited on the brightened surface of the hard steel, is so familiar to every mechanic, as to render a description of it here unnecessary; merely premising that the first colour, a very faint straw, indicates the hardest state of tempered instruments; this colour becomes deeper and deeper, by increase of heat, till it assumes a fine golden yellow, which changes, irregularly, to a purple, then to a uniform blue, succeeded by white, and several faint repetitions of these series.

A graduated scale, in reference to colour, drawn out by Stodart, and first promulgated, I believe, by the late Peter Nicholson, is as follows:—

At 430° Fahrenheit, a very faint yellow, for lancets.
450° ditto, a pale straw colour, for razors and surgeons' instruments.
570° ditto, a full yellow, for penknives.
420° ditto, a brown colour, for scissors and chisels for cutting old iron.
510° ditto, a brown, with purple spots, for axes and plane irons.
530° ditto, a purple, for table-knives and large shears.
550° ditto, a bright blue, for swords, watch-springs, truss springs, and bell-springs.
560° ditto, a full blue, for small saws, daggers, &c.
600° ditto, a dark blue, verging on black, is the softest of all the gradations, when the metal becomes fit only for hand pit-saws, which must be soft, that their teeth may bear sharpening by the file, and bending or setting.
If the steel be heated still farther, it becomes perfectly soft.

Mr. Nicholson farther explains the measures taken by Mr. Stodart, in order to ascertain the temperatures at which the several colours make their appearance on hardened steel: I had intended to have extracted the more valuable portions of Mr. Stodart's observations; but the great length to which this paper has already extended, compels me to refer the reader to "The Circle of the Mechanical Arts," page 262, where the matter is very ably discussed.

DESCRIPTIVE GEOLOGY.

(Continued from last Vol.)

THE TERTIARY PERIODS.

Introductory Remarks.—After the deposit of the secondary rocks, a remarkable change took place; for all the strata which lie above the chalk, have a totally different character from that rock and all below it. These *supracretaceous* strata have been classed together in one great division, and have been designated the tertiary formations.

Organic remains are the great characters of distinction in the different strata, and Mr. Lyell, in his "Principles of Geology," has proposed a division of the series founded upon the proportion of shells contained in the stratum which are identical with living species: that stratum being the most modern, where the proportion is greatest. In the present state of our knowledge, this arrangement is of great utility; but there cannot be a doubt, but that it will hereafter be abandoned as geological research progresses; because strata, in which no recent species have yet been found, may yield them to more accurate and extended observations.

Mr. Lyell has designated the four great periods, during which the tertiary strata were deposited, by the names of the Eocene, Meiocene, Older Pleiocene, and Newer Pleiocene Period. The

Eocene period containing	3½	per cent. of fossil shells identical with existing species.
Meiocene	20	
Older Pleiocene	50	
Newer	90	

See Charlesworth's "Mag. Nat. History," July, 1839; Lyell's "Principles of Geology," vol. 3; also, Lyell's "Elements of Geology," page 284—290.

The first or earliest period, which comprehends the deposits immediately after the chalk, is called eocene, from *eos*, a Greek word, signifying *early dawn*; because recent species first then begin to appear; the second period, meiocene, from *meion*, signifying a *minor quantity*; because a minority of the fossil shells, in formations of this period, are of recent species; the third period, the older pleiocene, from *pleion*, a *major quantity*; the fourth period, the newer pleiocene, from the increased proportion of recent species. The termination *cene*, is taken from the Greek, *rainos*, and signifies *recent*.

Organic Remains.

The state of preservation of the organic

remains of the tertiary works, is very different from that of fossils in the older rocks; the colours of the shells, and even the cartilaginous ligaments uniting the valves, being, in some cases, retained.

The number of the species of tertiary fossils is prodigiously great, as compared with that of even the rich and well-explored oolitic system; among them are far more fresh-water tribes, and far more terrestrial forms, than among all the older strata taken together; a conclusion which harmonizes perfectly with the leading fact of the history of their formation—viz. that before the period of their deposition, the great sea of Europe was broken into basins between ranges of monntains and masses of land, which, in various ways, influenced the deposits, and supplied some of their organic contents.

BIOGRAPHICAL NOTICES.

No. VII.

ALBERT DE HALLER, M. D.

(Continued from page 22.)

The labours of Dr. Haller, during his residence at Gottingen, were by no means confined to any one department of science. He was not more anxious to be an improver himself, than to instigate others to similar pursuits. To him, the anatomical theatre, the school of midwifery, the Chirurgical Society, and the Royal Academy of Sciences, at Gottingen, owe their origin. Such distinguished merit did not fail to meet with a suitable reward from the sovereign under whose protection he then taught. The King of Great Britain not only honoured him with every mark of attention which he himself could bestow, but procured him also letters of nobility from the Emperor. On the death of Dillenius, he had an offer of the professorship of botany at Oxford. The states of Holland invited him to the chair of the younger Albinus: the King of Prussia was anxious that he should be successor of Maupertius, at Berlin. Marshal Keith wrote to him, in the name of his sovereign, offering him the chancellorship of the University of Halle, vacant by the death of the celebrated Wolff. Count Orlow invited him to Russia, in the name of his mistress, the Empress, offering him a distinguished place at St. Petersburgh. The King of Sweden conferred on him an unsolicited honour, by raising him to the rank of knighthood of the order of the Polar Star; and the late Joseph II., Emperor of Germany, honoured him with a personal visit. Thus honoured by sovereigns, revered by men of literature, and esteemed by all Europe, he had it in his power to have held the highest rank in the republic of letters. Yet, declining all the tempting offers which were made to him, he continued at Gottingen, anxiously endeavouring to extend the rising fame of that medical school. But, after seventeen years' residence in that university, an ill state of health rendering him less fit for the duties of the important office which he held, he solicited and obtained permission, from the regency of Hanover, to return to his native city of Bern. His fellow-citizens, who might, at first, have fixed him among themselves with no less honour than advantage to the city, were now as sensible as others of his superior merit. A pension was settled on him for life, and he was nominated, at different times, to fill the most important offices in the state. These occupations, however, did not diminish his ardour for useful improvements. He was the first president, as well as the greatest promoter, of the Economical Society at Bern; and may be considered as the father and founder of the Orphan Hospital of that city. Declining health, however, restrained his exertions in the more active scenes of life, and for many years he was confined entirely to his own house. Even this, however, could not put a period to his utility; for, with indefatigable industry, he continued his favourite employment of writing, till within a few days of his death, which happened in the seventieth year of his age, on the 12th of December, 1777.

His "Elementa Physiologiæ," and "Bibliotheca Medicinæ," will afford, to latest posterity, undeniable proofs of his indefatigable industry, penetrating genius, and solid judgment. In his youth, during a residence of some time at Bienne, in 1723, he composed several pieces in the epic, dramatic, and lyric styles; his genius being awakened, by the romantic scenery of the country, to poetical enthusiasm. At this period, he was so entirely absorbed in his favourite study, that, on a fire breaking out in the house in which he resided, he rushed into his apartment, and rescued his poetry from the flames, leaving his other papers, with little regret, to destruction. Afterward, when a more mature age had ripened into judgment, he was frequently heard to say, that he had preserved from the flames those compositions which he then thought the finest productions of human genius, in order, at a future period, to consign them to destruc-

tion, as unworthy of his pen.* In the sequel, however, he was more successful in his poetical effusions. In 1729, he composed his poem on "The Alps;" a poem as sublime and immortal as the mountains which are the subjects of his song. He likewise wrote some ethic epistles on "The Imperfection of Human Virtue," on "Superstition and Infidelity," on "The Origin of Evil," and on "The Vanity of Honour;" various satires—"Doris," a pastoral, on his first wife, and his much-admired elegy on her death. It is a convincing proof of Haller's versatile genius and extraordinary mental powers, that he should have so eminently excelled in poetry, which, except in his early youth, he never considered otherwise than as an amusement, either to soothe him under afflictions and in the bed of sickness, or to console him for the envy and neglect of his contemporaries.

THE GREAT WESTERN RAILWAY ACCIDENT.

To the Editor of the Penny Mechanic and Chemist.

Sir,—In reply to "W. H.," I beg to state, that I am not so "unreasonable" as to think, anything like the amount of convenience or comfort is to be expected by third-class passengers, as that afforded to those who travel by a first or second-class train. Still I am of opinion, that there has been a culpable indifference on the part of the Great Western Railway Company, as to the security of this description of passengers, whose humbler circumstances do not make their lives of less value to themselves, than those moving in a more respectable sphere. From the evidence on the inquest, I think the conclusion to which every impartial person will arrive is, that the middle part of the train is the most secure position in which the passenger-carriages can be placed. As to ascertaining the speed by night, permit me to say, that I think "W. H.'s" remarks are absurd. The escape of the engineer and stoker, to which he alludes, in my opinion, is attributable, in some measure, to the presence of mind which such a mode of life as that to which they are accustomed is likely to produce. Momentary as was the alarm, I consider that self-preservation would as instantaneously prompt them to abandon their places on the engine from which they could more hastily disengage themselves—being open at the sides—than from one of the carriages in which the passengers are placed.

The cause of the detention of the train, prior to passing through the Box Tunnel was (as I stated), repairs, and not a mere casual obstruction. If it had been the latter, how could they calculate the exact time of the train passing for several successive mornings? And I still maintain, that the regulations of the Company respecting the tickets was, under the circumstances, most arbitrary.

I am, Sir, yours respectfully,

A.

THE GENERAL RECIPE BOOK.

Portable Glue.—Take ½ lb. of fine glue; boil and strain it clear; then boil 2 oz. of isinglass; put it in a double glue-pot, with 4 oz. of brown sugar, and boil it pretty thick. Pour it into a cool vessel; when cold, cut them into small pieces, and dry them. This is an excellent cement for paper, as it instantly dissolves in warm water, and firmly fastens the paper.

Method of Cleaning Playing Cards.—Nothing soils sooner than playing-cards. The following method will be found to remove everything from them but a stain, and will give the dirtiest back possible the appearance of being new. Rub the soiled card with a piece of flannel and fresh butter, until the butter shall have cleaned off all the dirt. So soon as the dirt is removed, wipe off the butter with a clean rag; and, to restore the card to its former gloss, rub the surface sharply with a piece of flannel and some flour. Cut the edges neatly with a pair of scissors, and the operation is completed.

Cure for the Ear-ache. Take a piece of

* Many of his biographers have confounded these two facts; and, from a natural proneness to exaggeration, have asserted, that at Bienne, Haller, with a greatness of mind above his years, burned his poetical compositions, from a strong conviction that poetry tended to alienate his mind from the severer studies; whereas, the very contrary happened. He saved his poetical pieces in preference to his other papers, and burned them afterwards, because they would have disgraced his reputation; although, as juvenile productions, they were not wholly without merit. I have, in this instance, preferred the authority of his particular friends, Balthasar and Ischarner, to his other biographers, who had not such opportunities of obtaining the truth. Besides, as confirmation of their evidence, Haller did not intermit his poetical studies, but wrote, at Tubingen, his "Morgen gedanken," and "Sehn-Sucht," which are the earliest specimens he ever gave to the public.—*Coxe's Travels in Switzerland*, vol. ii., p. 253, note.

lean mutton, about the size of a large walnut; put it into the fire and burn it for some time, till it becomes reduced almost to a cinder; then put it into a piece of clean rag, and squeeze it until some moisture is expressed, which must be dropped into the ear as soon as the patient can bear it.

To Soften Horn.—To 1 lb. of wood ashes add 2 lbs. of quicklime; put them into a quart of water; let the whole boil till reduced to one-third; then dip a feather in, and if, on drawing it out, the plume should come off, it is a proof that it is strong enough. When it is settled, filter it off, and, in the liquor thus prepared, put shavings of horn. Let them soak three days, and, first anointing your hands with oil, work the whole into a mass, and print or mould it into any shape you please.

Cure for Smokey Chimneys.—Inflate a large ox bladder with air, and tie it by the neck to the middle of a stick, which place across the inside of a chimney, about two feet from the top, or at the foot of the chimney-top. The buoyancy of the air keeps the bladder continually in a circular motion, and thereby prevents the rush of air into the tunnel from descending so low as the fire-place.

To Clean Oil Paintings.—Oil paintings frequently become soiled with smoke or dirt, when they must be treated with great care. Dissolve a small quantity of salt in some stale urine; dip a woollen cloth in the mixture, and rub the paintings over with it till they are clean; then wash them with a sponge and clean water, dry them gradually, and rub them over with a clean cloth. Should the dirt be not easily removed by the above preparation, add a small quantity of soft soap. Be very careful not to rub the painting too hard.

To make Black Varnish.—Best sealing-wax, ½ oz.; rectified spirits of wine, 2 oz.; powder the sealing-wax, and put it in with the spirits of wine, into a four-ounce phial; digest them in a sand heat or near the fire, till dissolved. Lay it on warm with a fine hair-brush. Spirits of turpentine may be used instead of spirits of wine.

To make Cheap Blacking.—Ivory black and brown sugar-candy, of each 2 oz.; sweet oil, a tablespoonful; add gradually a pint of cold vinegar, and stir the whole gently till incorporated.

To make a good Lacquer for Brass.—Take of rectified spirits of wine, 2 quarts, and 3 lbs. of seed lac, picked particularly clean, and clear of all black and brown specks and pieces, as upon that depends the entire beauty of the lacquer; add them together, keep them warm, and shake them often.

To make Turpentine Varnish.—Take one gallon of spirits of turpentine, and add 5 lbs. of resin, pounded; put it in a tin can on a stove, and let it boil half-an-hour. When cold, it is fit for use.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, Jan. 26, R. A. Ogilvie, Esq., on the Physical Properties of Air. Friday, January 28, J. S. Buckingham, Esq., on Arabia. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, January 27, Robert Hunter, M.D., on the Evidences of Design as Displayed in the Structure and Physiology of Man. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Jan. 24, Hyde Clark, Esq., F.L.S., &c., on the Literary and Historical Associations of London. At half-past eight.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, Jan. 25, Mr. Dart, on Chemistry. At eight o'clock.

QUERIES.

"G. S., Jun.," will much oblige "A. B.," by informing him the lowest price he (A. B.) could manufacture an organ of four stops for; purchasing the pipes of a manufacturer, and completing the other parts himself. A. B.

The receipt for ink used for writing on lithographic stone? A. S.

Why is arsenic used in candles; and will any other chemical preparation answer the same purpose? A. S. R.

What is the construction of Stockre's electro-magnetic engine? W.

Is C. Macintosh and Co.'s patent out, or not? F. Jones.

What can I put in lacquer to make it a dark-brown colour on work when lacquered; if it approaches black it will not matter, as I want it of a very dark colour? J. H.

ANSWERS TO QUERIES.

"W." had better apply to the inventer and manufacturer of the chiragone, Mr. Sadolph, 7, Bedford Place, Kensington.

I have a capital electrotype apparatus, consisting of six cells of a Daniell's battery, in tray, with binding screws, decomposition trough, a quantity of copper connexions, and apparatus for constructing porous tubes, on a very economical principle. The above is admirably adapted for gilding and silvering. They are all in extremely good condi-

tion, and will be sold a great bargain, and may be seen any day, on applying at No. 37, John Street, Union Street, Walcot Place, Lambeth.

J. D. I.

Cause of the Explosions in Coal Mines.—The gas which causes the explosion, is known by the miners under the name of fire-damp, subcarburetted hydrogen, and a variety of other appellations; but its proper chemical name is bihyduret of carbon, or light carburetted hydrogen.

Its equivalent by weight is 8. = carbon 6 × 2 hydrogen;

Specific gravity 0.555;

Weight of 100 cubic inches 16.92 grs.

Bihyduret of carbon has neither taste nor smell; when pure, cannot support combustion or respiration, and is absorbed very sparingly by water; it burns with a yellow flame, and consumes twice its weight of oxygen during its combustion; the two equivalents of hydrogen, which it contains in a condensed state, combining with two equivalents of oxygen, and forming water, while the carbon unites with as much more oxygen, and is converted into carbonic acid. No process has been pointed out by which it may be procured with facility in a pure state; it is, perhaps, procured most easily, by stirring the mud at the bottom of stagnant pools, and collecting the gas, which is disengaged, in glass vessels inverted over it, full of water; a large quantity being formed there by the decomposition of dead vegetable matter. Small quantities of this gas are formed in a great number of processes, as in some of those for the preparation of olefiant gas; and most vegetable substances afford a considerable quantity, when they are exposed to heat in close vessels. It is almost always mixed with a small quantity of carbonic acid, when obtained by any of the above processes, as well as when procured from the coal mine, where it is generated in large quantities. This gas may be removed, by washing it with lime-water or a solution of potassa. Bihyduret of carbon forms an explosive mixture, when mixed either with oxygen or atmospheric air, merely requiring a larger proportion of the latter to produce the same effect. The pure gas does not form an explosive mixture, unless mixed with more than four times its volume of air, and the explosion is feeble, till seven or eight times its bulk is added; with more than fourteen times its volume of atmospheric air, it merely causes a lighted candle introduced into it, to burn with an enlarged flame, without explosion; with oxygen, the detonation takes place violently, with two or three times its volume of this gas—the products of the combustion being water and carbonic acid gas. The latter is commonly called, by the miners, choke-damp, being non-respirable, and frequently destroys those who have been fortunate enough to escape the violence of the explosion. The cause why the safety-lamp does not inflame an explosive mixture without the gauze, though it can freely enter and burn within, is this:—A very great heat is required to inflame most bodies in the gaseous state; and, when they become luminous, so as to constitute flame, their temperature is above the white heat of solid bodies: but when any gaseous matter, in the state of flame, passes through the minute apertures of the wire gauzes, its temperature is so much reduced, that it ceases to be luminous, and is incapable of inflaming any explosive mixture that may be without. The metal, also, of which it is composed, being a good conductor of caloric, gives it off quickly to the external air, when heated; so that it is always sufficiently cool to reduce the temperature of any gas that may be burning within the gauze, as it passes through; nor does it become so hot, as to be able to inflame an explosive mixture itself. An experiment on a small scale will easily illustrate this:—Take a piece of iron or brass-wire gauze, nine inches square, and of such fineness, as to have about thirty meshes in the square inch; bring it down gradually upon the flame of a wax candle..or, what is better, upon a jet of coal gas..the flame will be cut off where it touches the gauze. In this case, the inflammable matter of the flame (in the form of smoke) passes through the wire gauze; but, in its passage, is so far cooled, as to be extinguished, and the flame is thus prevented from traversing the wire gauze. If a lighted taper is now applied above the flame, to the upper side of the wire gauze, the gas or smoke will be kindled, and the flame continue to burn uninterruptedly. If the meshes of the gauze used in this experiment, be not sufficiently small, or if the wire becomes intensely heated, the flame will pass, in either case; because the cooling power is, in one instance, prevented by the largeness of the apparatus, and, in the other, by the high temperature of the wire.

E. F. B.

TO CORRESPONDENTS.

J. R. S.—*There is no means of taking out grease from paper, except with turpentine, which leaves as bad a spot as the grease itself; nor can ink be removed except with a penknife.*

Leo.—*To make cold cream, take of oil of almonds, 2 oz.; white wax and spermaceti, of each two drachms. Melt by a gentle heat, and, while warm, stir in orange-flower water, 2 drachms; otto of roses, 2 drops.*

Many of our correspondents complain of their queries, &c. not being inserted in the next Number; and others send their communications with a particular request, that they may appear in the forthcoming Number, but which are received after the Magazine has gone to press. We again repeat, that, owing to our extensive circulation, we are compelled to go to press at an early part of the week; therefore no communication can be inserted, if received later than the Monday prior to the day of publication.

In the last Number, figs. 4, 5, 6, 7, and 8, were inverted. Our readers, however, will perceive the mistake, and pardon us for the trouble it may have occasioned.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country

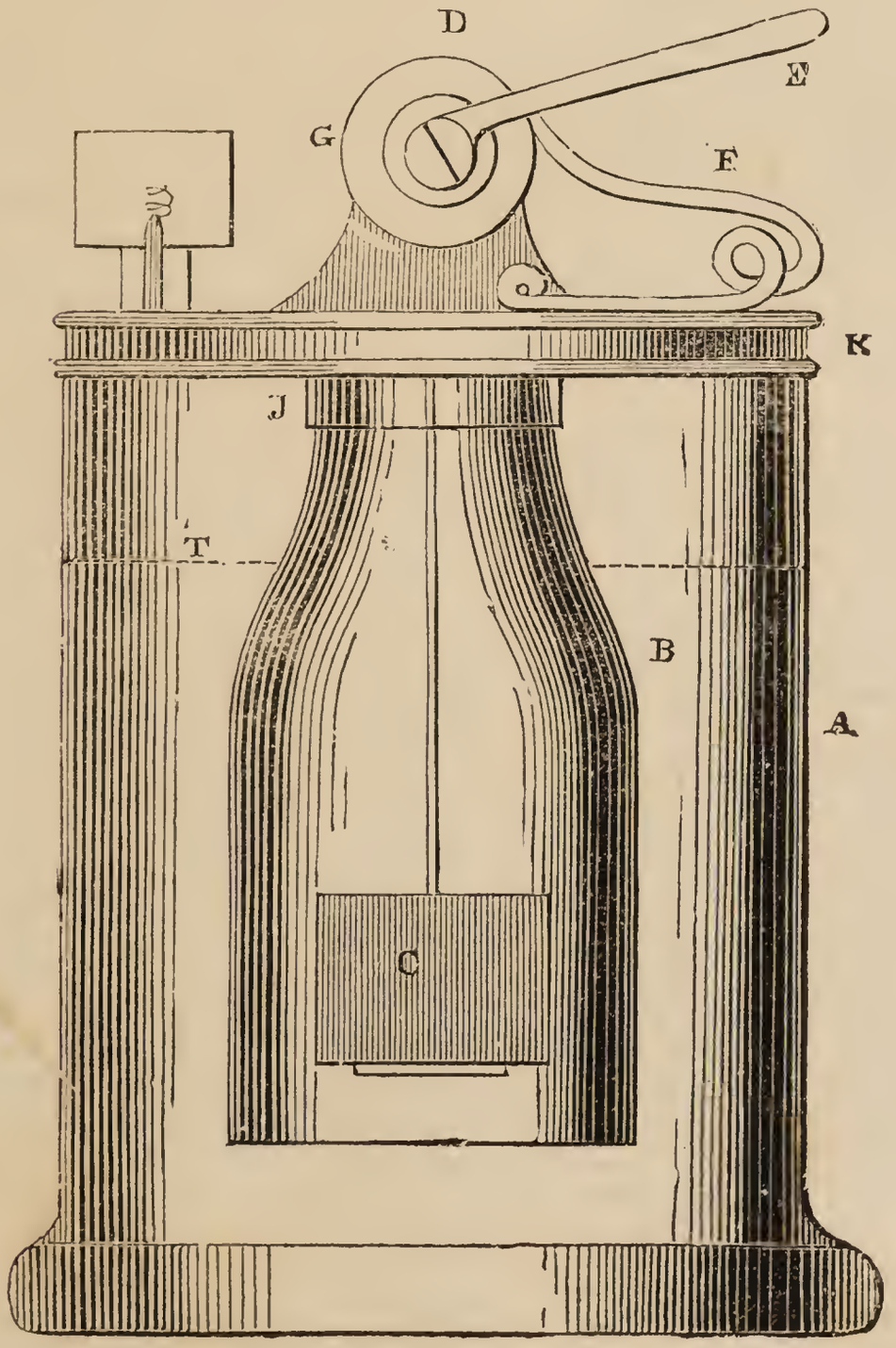
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 64, THIRD SERIES. | SATURDAY, JAN. 29, 1842. | No. 312, OLD SERIES.

PORTABLE GAS-APPARATUS.



Vol. VIII.—No. 5.] [City Press, 1, Long Lane, Aldersgate Street: D A. Doudney.

PORTABLE GAS-APPARATUS.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—The following is a description of a portable gas-apparatus, that is coming into general use instead of lucifer matches, &c., which, I trust, will be worthy a place in your valuable Magazine.

Portable gas is no other than hydrogen; a stream of which, being forced through a small coil of platina wire, ignites. The engraving will better explain its construction.

Description of the Engraving.

A is a glass jar, made strong, which holds about a pint or a pint and a half.

B is a small glass receiver, which is fitted on the brass top, K, by means of a brass collar and a little cement; the brass top, K, being loose, as it may be taken off and put on at pleasure.

C is a piece of zinc, hung inside the receiver by means of a piece of wire.

D is a brass cock, with a small jet at G, being drilled as fine and straight as possible.

H, a piece of tube, containing the platina wire. A piece twisted round twice or three times, will answer the purpose. The cock is turned by means of a small lever, E, by pressing it down.

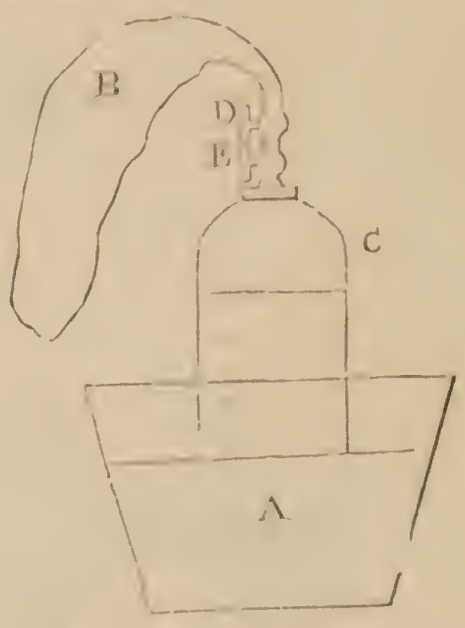
F, a spring made of wire, which lifts the lever in its place again, and prevents the gas escaping, by taking off the top, K, and filling the glass jar about three parts full of dilute acid (one part sulphuric acid to one eighth part water), and then, replacing the top, the receiver will remain empty; but, by turning the tap, the acid will rise to the receiver. Hydrogen will soon fill the receiver, the tap being closed against the receiver full of gas, which is replenished in about the eighth part of a minute by the action of the acid on the zinc. The small quantity of the acid left on the zinc, will cause the acid to sink below the bottom of the zinc, which must be placed within the eighth part of an inch of the bottom of the receiver.

I remain yours, &c.,

W. R. Lomax.

METHOD OF OBTAINING LAUGHING-GAS.

There are various methods of making laughing-gas, but I think the following is the cheapest and easiest method of obtaining it:—Heat nitrate of ammonia in a retort over a spirit-lamp, being careful to keep it only simmering; for if the heat be increased too much, a slight explosion will follow, and nitric oxide and nitrogen gas will be produced. It should stand over water a short time, in order to remove any impurities by which it may be contaminated. A bladder, capable of holding a few quarts of gas, will be large enough. The apparatus is shown by the following diagram:—



A A, a bucket filled with water, in which the glass receiver, C, must be placed; this can be done by unscrewing the bladder, B; the part where it is made to screw being between the stop-cocks, D E. By turning the stop-cock, E, the air will allow the water to rise in the receiver, which, when quite full, must be turned again, bringing the bottom of the receiver to the surface of the water. The mouth or end of the retort may then be placed in the water, so that the gas may rise in the receiver and displace the water, which will descend into the tub again. When the gas has stood over the water a short time, the bladder may be screwed on again; both cocks may be turned, and the gas forced into the bladder, which may be done by pressing the receiver in the water; the bladder is then taken off, taking care to turn both cocks off. Unless the person inhales it from the bladder, without allowing any of the atmosphere to enter his lungs at the same time, the experiment will not succeed. The best way is to close the nostrils with the left hand, and then forcing all the air possible from the lungs by a strong respiration, to place the stop-cock in the mouth, and so breathe in and out of the bladder. If you follow this plan, the gas is sure to produce its usual effects.

W. R. L.

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS, &c.

(Continued from page 28.)

At this stage of the inquiry we may remark, that steel hardens as well under cover, as if exposed, provided it can be cooled in the requisite time. Delicate articles are, therefore, frequently enclosed in a metal box, perfectly air-tight, and thus subjected both to the heat of the fire and the cold temperature of the water, without bringing the articles in question into immediate contact with either—at least while under the influence of the atmosphere, and in an ignited state.

The slow conducting power of lamp-black has been found a very useful agent in protecting particular parts of any instrument during the process of hardening the remaining portion. For instance, suppose we wish to harden the neck of a lathe-mandrel, but not the outside screw, lest it should break when roughly used; this may be done by means of an iron tube, fitted a little way on the neck of the mandrel, and ramming the intervening space between the screw and the interior surface of the tube full of lamp-black, so as completely to envelop the screw; the orifice of the iron tube or case is then to be closed by a metal plug; the mandrel being hardened in the usual way, the exposed parts will be hard, and the protected portions will remain soft.

It now remains for me to show, by some few references to the best authorities to which I have access, how far the practical details I have produced, are borne out by chemical analysis.

It appears that steel is iron in an intermediate state between cast and malleable iron;* or, perhaps, a more correct expression of the distinction between cast iron and steel is, that the former is charged with a superabundant, the latter with a minute, yet sufficient, dose of carbon; yet steel has been called carburetted iron. The first attempt to investigate the nature of steel was by Reaumur, in a book which he published in 1722, intituled, *L'art de convertir le fer forgé en acier, et l'art d'adoucir le fer fondu, ou de faire des ouvrages de fer fondu aussi fines que de fer forgé.* This eminent philosopher considered steel as iron impregnated with sulphureous and saline matters. The efficacy of charcoal in converting iron into steel, is supposed to have been known centuries ago; at least a manufacture of steel is proved to have existed in Sweden as early as 1340; but the actual process of cementation is said to have originated in England. At the time Reaumur wrote, it was generally imagined that charcoal consisted almost entirely of *phlogiston;* and the inference deduced was, that steel differed from iron in containing a greater quantity of phlogiston. This opinion prevailed till the celebrated experiments on iron, promulgated by Bergmann in 1781. He showed that, when a given weight of cast iron was dissolved in dilute sulphuric acid, the hydrogen gas evolved, varied from 38 to 43 volumes; that from the same weight of steel, varied from 45 to 48 volumes, while that from the same weight of hammered iron, varied from 48 to 50 volumes. Now at this period, the hydrogen gas given out was conceived to be the phlogiston of the metal. Hence it is to be inferred from these experiments, that pure iron contains the *most*, and cast iron the *least*, phlogiston; thus reversing the commonly received opinion.

It is to be remarked, that when these different kinds of iron were dissolved in dilute sulphuric acid, a quantity of insoluble matter invariably remained—which Bergmann designated *plumbago*—and consisted chiefly of carbon; and when this plumbago was burnt away, a little silica always remained.

100 parts of cast iron yielded from 1 to 3.3 of this plumbago;
100 parts of steel, from 0.2 to 0.8 ditto;
100 parts of hammered iron, from 0.05 to 0.2 ditto.

Hence it was concluded, that carbon enters as a constituent into cast iron and steel, but not into hammered iron.

In 1786, an elaborate dissertation on the same subject, by Monge, Berthollet, and Vandermonde, appeared in the Memoirs of the French Academy; they examined the experiments of Bergmann, and added a considerable number of their own, and drew, as a final conclusion, that hammered iron, if pure, consists of iron free from all heterogeneous matter; that steel is a combination of iron and carbon, and cast iron a combination of iron, with a still greater quantity of carbon, and not free from oxygen. These opinions, with the exception of the oxygen in cast iron, have been acceded to by succeeding chemists.*

Dr. Thomson gives, as the specific gravity of blistered steel, soft, 7.823; and

* Imperial Encyclopædia, vol. iii., p. 161.

* Dr. Thomson's "Chemistry of Inorganic Bodies," vol. i., page 498.

of the same description of metal, hard, 7.747; likewise of cast steel, soft, 7.8227; and of the same, hard, 7.7582. This evidently accounts for the increase in bulk observable in hardened steel; since it cannot be doubted, that the volume which steel acquires by heating it to redness, is retained; the cold water solidifying the surface before the mass has had time to contract.

Dr. Thomson analysed the several varieties of cast iron known in commerce, with his usual acumen, and gives, as the mean of his experiments on *white cast iron*,

Iron	95
Carbon	5
	100

Estimating a small proportion of silicon with the carbon, this approaches very nearly to

Iron, 4 atoms*	14
Carbon, 1 atom	0.75
	14.75

Hence he concludes, white cast iron is essentially a compound of iron, 4 atoms, carbon 1, and its atomic weight 14.75.

His experiments on *black cast iron* were not so successful; but they justified the conclusion, that it is a compound of

Iron	93.4
Carbon	6.6
	100

Which comes very near

Iron, 3 atoms	10.5
Carbon, 1 atom ..	0.75
	11.25

And he considers black cast iron as a compound of iron, 3 atoms, carbon 1; if so, its atomic weight will be 11.25.

With regard to *grey* or *mottled cast iron*, Dr. Thomson was unable to procure any specimen of a sufficiently decided character, to warrant his treating it as specifically distinct from black cast iron; he, consequently, did not attempt an analysis, but considers it possible that mottled cast iron may be a compound of

Iron, 3½ atoms..	12.25
Carbon, 1 atom..	0.75
	13.

* I have used the expression *atom*, because I find it in Dr. Thomson's work. Had I followed my own judgment, I should have employed *equivalent*, or *combining proportion*, instead of a term of doubtful meaning.

Now these varieties of cast iron are usually distinguished, by designating the *black* sort, No. 1, the *mottled* or *grey*, No. 2, and the *white*, No. 3.

No. 1 is said to be the softest of the three, its specific gravity varying from 6.90102, to 6.836; it is imperfectly malleable, and admits of being easily turned and filed down.

No. 2 derives its name from the inequality of its colour; its specific gravity is 7.0683: it is harder than No. 1, but soft enough to be cut, bored, and turned in the lathe.

No. 3 approaches silver in colour; its texture is fibrous or crystalline, and its specific gravity 7.6849. It is so extremely hard, that it can neither be turned, bored, nor filed; moreover, it is very apt to break when suddenly heated or cooled.

Besides iron and carbon, cast iron is not quite free from silicon; it frequently contains, also, a trace of magnesium, and not rarely a little manganese; though all these constituents are so variable in point of quantity, that nothing definite can be asserted respecting them.

DESCRIPTIVE GEOLOGY.

(Continued from page 29.)

MAMMALIA.

Among the various mammiferous animals found fossil in the tertiary series of Europe, it is only among the more modern deposits that any question can arise, as to whether they are, or are not, analogous to existing species; and even then there are few remains which can lead to a doubt of the whole mass of mammiferous life entombed, being specifically distinct from that now living. Not only have species disappeared at this epoch, but whole genera have been swept away from among animals existing on the surface of our planet. Of the eighty extinct species of mammals discovered by Cuvier, and described by him in his great work, "Sur les Ossemens Fossiles," fifty appertain to the order pachydermata (animals with thick hides); thirty-eight of these belong to eleven distinct genera, which have no representatives among living animals. These serve to connect the existing genera of pachydermata with one another, and to complete that gradation of character, which, before their discovery, was so imperfect in this order of animals.

Fishes.—Hitherto M. Agassiz has not found a single species of fish, which he

considers perfectly identical with those of our seas, except the little fish which is found in Greenland, in geodes of clay, and whose geological age is unknown to him.

Shells.—No species of fossil shell has yet been found common to the secondary and tertiary formations. The total number of known fossil shells in the tertiary series, is 3036. Of these, 1238 are found in the eocene, 1021 in the meiocene, and 777 in the older and newer pleiocene divisions.

Plants.—The tertiary deposits abound in palms and tree ferns; and dicotyledonous trees begin to prevail to a greater extent than in the secondary. These strata include many terrestrial, lacustrine, and marine plants. Fossil fruits of existing genera—as pandanus, cocos, pinus, almus, acer, salix, &c., present the essential characters of the modern flora.

The number of species of plants in the various divisions of the tertiary strata, is as yet imperfectly known. In 1828, M. Ad. Brongniart considered the number then discovered, but not all described, to be 166.

Time taken in Depositing the Tertiary Works.—Enormous lacustrine deposits are included in the tertiary masses. These are sometimes made up of very fine thin laminæ, marking slow tranquil deposits. Among those laminæ are found sometimes the leaf sheddings, and the insects of successive seasons. Among them, also, we find almost mountain masses of the *indusiæ tubulatæ*,* and other sheddings of insects, year after year. Streams of ancient lava alternate with some of these lacustrine tertiary deposits. So that we have demonstrative proofs of a long succession of physical events, each of which required a long lapse of time for its elaboration. See Prof. Sedgwick in Dr. Pye Smith's recent work on "The Relation between the Holy Scriptures and some parts of Geological Science," p. 415.†

* These are cylindrical cases, formed for its habitation by a six-legged insect larva, which inhabits ponds and small streams, creeping at the bottom. The cases are constructed of small portions of leaves and stalks, laid and finely-joined together, agglutinated by a secretion of the insect, lined with a silky fibrous matter, and defended on the outside by small substances of a harder texture, made to adhere by the insect's gluten—such as minute bits of wood or bark, grains of sand, and very small shells. When it quits the larva state, it comes out a brownish four-winged moth-like insect. Often ten or twelve of these cases are packed up, as it were, yet not broken, within the compass of a cubic inch.

† For some other remarks on geological time, see the introductory remarks to the "Secondary Periods."

BIOGRAPHICAL NOTICES.

No. VIII.

ALBERT DE HALLER, M. D.

(Continued from page 30.)

A FEW supercilious critics have reproached his poetry with occasional obscurities, and accuse him of having introduced a new language affectedly averse to the common modes of diction. Cold criticism may censure; but twenty-two successive editions of his German poems, and the translation of them into the principal languages of Europe, prove that they possess the great aim of poetry, that of pleasing and instructing the reader. And it may be remarked with truth, that although Haller's stupendous labours in erudition and science render his poetical talents of inferior account, yet that if he had confined himself to poetry, that alone would have immortalized his name. His writings have greatly enriched the study of botany. He was not less distinguished as a philosopher, a physician, a botanist, a naturalist, and a poet, than beloved as a man; and he was not more eminent for his knowledge in every department, than for his piety to God, and his benevolence to mankind. To his other writings he added, in the German tongue, "Letters to his Daughter," on the truth of the Christian Revelation. He published an extract of Ditton's "Truth of the Resurrection of Jesus Christ," which he acknowledges to have first cleared any doubts he might entertain on the subject. He avows at the same time, that he received infinite satisfaction from the study of the New Testament, because he was never more certain of holding converse with the Deity, than when he read his will in that divine book. In 1775, he finally gave to the public, also in the German language, "Letters concerning several late attempts of Freethinkers, yet living against Revelation." In this work the author examines and refutes the objections to Christianity, advanced in so lively and dangerous a manner by Voltaire, in his "Questions sur l'Encyclopædia.' "If this latter publication," adds Sennebier, "may be considered as an index to the doubts and arguments against the Christian religion, the work of Haller may be entitled, An index to the answers in favour of the same Revelation, to be consulted by those who wish impartially to discuss both sides of this important Question. 'When learning and philosophy, instead of being employed in supporting sceptical tenets by artful sophistry, thus lend their united assistance to the cause of religion, they

then truly become an honour to the possessor and a benefit to society.

Even this great and good man was not exempt from a too anxious solicitude for his welfare in a future state. That depression of spirits which ought justly to be considered as the effects of disease, and the warmth of his imagination conspiring, perhaps, with the narrow principles of Calvinism, in which he had been educated, led him to reflect rather on the *justice*, than the *mercy*, of the Deity, and to bewilder himself in the endless mazes of predestination and grace. At another moment, animated with a passion for science, he breaks out, in a letter to his friend Bonnet, into the following exclamation, expressive of his regret to quit a world which he had improved by his discoveries, and which he might still farther illuminate by his zeal and application:—"O my poor brain, which must return to dust; and all the knowledge and information which I have been collecting with such unwearied labour, will fade away, like the dream of an infant."

He continued his labours, and preserved his senses and composure, to the last moment. He beheld his end approaching without fear and regret.

"My friend," said he to the physician who attended him, "I die; my pulse is stopt"—and then expired. He died on the 12th of December, 1777, in the seventieth year of his age. Thus lived and thus died, the great Haller; a man to whom Michælis, the eminent orientalist, justly applies an observation which had been made on the genius of Aristotle:—"Neque cœlo, neque terrâ, neque mari quicquam relinquere voluit incognitum, indole præterea adeo mirabili ut ad singula naturæ præcipue dicas."*

As it was his custom to make extracts, and to give his opinion of every book which came into his hands, as well as for his own private use as for the "Gottingen Review,"† he read most new publications; and so eager was he, usually, in the perusal, that he laid them upon the table even when he was at dinner, occasionally looking into them, and marking those parts with a pencil which he afterwards extracted or commented upon. He was accustomed to make his remarks on small pieces of paper of different sizes, which he placed in order, and fastened together: a method he learned from Leibnitz.

He derived from nature extreme sensibility, or, rather, irritability of temper, which is ever the child of genius. He spoke, therefore, from his own experience, when, in a letter to Voltaire, he thus expressed himself:—"Providence holds with an equal hand the balance of human happiness. He has loaded you with riches, he has loaded you with glory; but misfortune was necessary, and he preserved the equilibrium, by giving you sensibility. If my wishes could take effect, I would bestow upon you that tranquillity which flies at the approach of genius, which is inferior to genius in relation to society, but far superior in regard to ourselves: then the most celebrated man in Europe should be, at the same time, most the happy."

He was always impatient under sickness, as well from his extreme susceptibility of pain, as because he was precluded, in that situation, from his literary occupations. He was fond, therefore, of taking violent remedies, more calculated to remove the immediate effects of pain and to check his disorder, than to cure it radically. In his latter years he accustomed himself to opium,* which, operating as a temporary palliative, only increased his natural impatience. This restlessness of temper, which occasionally disturbed his tranquillity, even in his younger days, and in the full flow of his health and spirits, was considerably heightened by the advance of age, and the disorders which shattered his frame towards the close of his days.

His correspondence in every period of his life, was extensive, punctual, and carried on in the English, French, German, Latin, and Italian languages. Haller was three times married; first to Marianne Wytsen in 1731, who died in 1736; second, to Elizabeth Bucher, in 1738, who died in childbed the same year; third, in 1739, to Amelia Rederica Teichmeyer, a German lady, who survived him. He has written and published the lives of his first two wives. He left eight children, four sons and four daughters, all of whom he lived to see established. His eldest son, Gotlieb Emanuel, who was born in 1735, followed his father's example, in dedicating himself to the service of his country,

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* He left nothing unexplored, either in the heavens, on the earth, or in the sea; and was of such a wonderful capacity, that he seemed born for the immediate objects of his pursuit.

† Haller viewed as his department for that literary journal, all publications on history, medicine, anatomy, natural history, and several miscellaneous works; particularly those which appeared in Italy.

* Zimmerman informs us, that he took daily so large a quantity as eight grains.—*Ueber die Einsamkeit*, page 216; ed. Leipsic, 1784.

and to the pursuits of literature. He was elected member of the great council, and obtained various employments under government, particularly by the bailliage of Nyon, in which situation he died, 1786. He distinguished himself as an author by various publications, tending to illustrate the history and literature of Switzerland, and particularly by his "Schweitnerbibliothe," or Swiss library, in six volumes, of which he lived only to publish the last. In this work, deservedly esteemed for its method and accuracy, the indefatigable author enumerates all the books which treat of Switzerland, in all languages, and all the works published by the Swiss on all subjects. He even descends to the minutest articles which have appeared in reviews and journals; and, in most instances, when the publication deserves detail, analyses the contents, corrects the errors, and gives his opinions on the merits of the performance.

CHARACTER OF ENGLISH AND FOREIGN ARTISANS.

No. 1.

Much of the information contained in these papers has been extracted from the evidence given to Edward Chadwick, Esq., Secretary to the Poor Law Commissioners, by various manufacturers from different parts of the world. It is contained in "Reports on the Training of Pauper Children. 1841."

Albert G. Escher, Esq., was first examined. He is one of the partners of the firm of Escher, Wyss, and Co., of Zurich. This firm employs from 600 to 800 men in their machine-making establishment at Zurich. It also employs about 200 men in their cotton-mills there; and about 500 men in their cotton-manufactories in the Tyrol and in Italy. The gentleman above mentioned has had, occasionally, the control of from 500 to 600 men, engaged in engineering operations, as builders, masons, &c., and men of the class called navigators. The men were natives of most of the European countries. In answer to the question,

"In what order do you class the workmen of various nations in respect to such natural intelligence as may be distinguished from any intelligence imparted by the labours of the schoolmaster?"

Mr. Escher said, "I class the Italians first; next the French; and the northern nations (in which the English are included) very much on a par."

The Italians' quickness of perception is shown in rapidly comprehending any new descriptions of labour put into their hands, of quickly comprehending the meaning of their employer, of adapting themselves to new circumstances, much beyond what any other classes have. The French workmen have the like natural characteristics, only in a somewhat lower degree. The English, Swiss, German, and Dutch workmen have all much slower natural comprehension.

When considered as workmen *only*, the preference is, undoubtedly, due to the English; because they are all trained to special branches, on which they have had comparatively superior training, and have concentrated all their thonghts. As men of business, or of general usefulness, and as men with whom an employer would best like to be surrounded, the Saxons and Swiss are to be preferred—especially the former, inasmuch as they have had a very careful general education, which has extended their capacities beyond any special employment, and rendered them fit to take up, after a short preparation, any employment to which they may be called.

It appears to be the unanimous opinion of all the employers examined, that the better educated workmen possess superior moral habits in every respect. They are entirely sober; they are discreet in their enjoyments, which are of a more rational and refined kind; they are more refined themselves; and they have a taste for much better society, which they approach respectfully, and consequently find much readier admittance to it; they cultivate music; they read; they enjoy the pleasures of scenery, and make parties for excursions into the country; they are economical, and their economy extends beyond their own purse to the stock of their master; and they are constantly honest and trustworthy.

(To be continued.)

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, Feb. 2, R. A. Ogilvie, Esq., on the Physical Properties of Air. Friday, February 4, J. Hemming, Esq., on Chemistry. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, February 3, William Jones, Esq., on the Characteristic Distinctions of Animate and Inanimate Matter. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Jan. 31, Mr. W. Baker, on the Importance of Chemistry as regards the Happiness of Mankind. At half-past eight.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, Feb. 1, Mr. Dart, on Chemistry. At eight o'clock.

QUERIES.

Where can I procure clay for modelling busts, what implements are required, and a brief account of the process, or reference to a cheap work in which it is given? J. Thorn.

What would be my best plan to bring out an improvement for cutting screws in the lathe? The traversing mandrel being very expensive, and my improvement answering the purpose much better, and less than one-fourth the expense, it would be worth registering, at least. Not being in the business, I know not to whom to apply, as a likely person to give me something for the invention. I should be content with a very small sum, but should like something, if only to prove that the invention is of value. G. S., Jun.

Having made a few penknife blades lately, in hardening them, I have found them warp very much; I shall, therefore, feel obliged by being informed what steel the cutlers use for them, and where I can buy it, and the best method to harden them, to prevent them from warping.

A. S.

In what manner is wire straightened without hammering; or is it done by drawing the wire through zig-zag pins? If so, how are those pins to be placed; or is there any other improved plan? W.

The cheapest place to buy materials for a galvanic battery, and to obtain directions for the same? J. Fitzpatrick.

Will a jar, made of thin cedar, answer the purpose as a substitute for the porous jars for the electrotype; as I find the ones which I buy at the chemists', split almost directly they have been put in use? Likewise the cheapest place to buy the sulphate of copper? Also, how the liquid is used for bronzing the medals sold at the Polytechnic at 1s. a bottle? The price of an apparatus that would be large enough to take a plate the size of a quarto demy? M. O. X.

How to make the amalgam used for the zinc for Smee's voltaic battery? Y.

What is the mechanism necessary to produce the *piano* and *forte* parts in seraphines? What constitutes the difference between those fine organ-toned accordions and the common ones? is it superiority of metal used for tongues, manufacture, or mechanism? M.

I must again trespass upon "M. R. C. S.", by informing me by whom the "Anatomist's Vade Mecum" was published. G. Starkey.

How to make pink ink? C. A. R.

ANSWERS TO QUERIES.

Permanent Marking Ink, requiring no Preparation.—Dissolve 1 grain of argenti nitras (nitrate of silver) in ½ oz. of water; add to the solution as much liquid ammonia as will redissolve the precipitated oxide, with sap green to colour it, and gum-water to make the volume amount to 1 oz. Traces written with this liquid, should be first heated before the fire, to expel the excess of ammonia, and then exposed to the sun to blacken.

"T. Brooks" will find a full description and the specific gravity of nickel, in the last volume, under the head mineralogy. G. Starkey.

To Detect Nitric Acid in a Solution supposed to contain it.—The simplest test is to add to the fluid suspected to contain free nitric acid, bicarbonate of potassa, as long as any effervescence is produced, then filtering and evaporating to dryness. One half of the residue may be submitted to deflagration on ignited charcoal, the other may be dissolved in a small quantity of water, and being put into a phial, into which a curved tube is fitted by means of a cork, and some copper filings and a few drops of sulphuric acid being added, and the phial heated, nitrous gas is extricated. The presence of this gas is at once recognised, by directing it upon some grains of morphia or of brucia; or passing it through a solution of protosulphate of iron. The reddening of the morphia or brucia, and the deepening the colour of the protosulphate of iron to a deep olive, is the demonstration that the suspected fluid contained nitric acid. The presence of any nitrate can be readily detected, by performing the latter part of the process.—*Pharm. Transactions.*

J. A. Spencer.

Cause of Steel Turning Blue.—It is stated in various chemical works, that the cause of steel blueing, when calorie is applied, is its attracting oxygen from the atmosphere; and the proof that is brought forth to support that theory is this:—That steel will not blue when excluded from the atmosphere, as covered with grease or hydrogen gas, for instance. It is evident the last-named experiment has not been tried, on account of the expansion and consequent explosion of that gas when heated. I have placed steel under the exhausted receiver of the air-pump, and find that it will blue when entirely excluded from the atmosphere; which shows that it is not the attracting of oxygen from the atmosphere, but the giving up of its own. The cause of the blue, I attribute to the calorie expanding the steel; when the carbon and oxygen contained in the steel, rising to the surface, causes the blue, on account of the acidulous properties of the oxygen; which is proved, as in the tempering of sword blades. For instance when the charcoal is made red hot, and the carbon, attracting the oxygen from the steel, forms the blue on the surface, and is entirely removed if exposed too long, or to the action of muriatic acid, which attracts or absorbs the oxygen from the steel. The cause of it not blueing when covered with oil, grease, &c., is the hydrogen, carbon, and small quantity of oxygen, contained in the oil or grease attracting the oxygen from the steel, as quicky as it rises to the surface.

T. R. Bilbrough.

TO CORRESPONDENTS.

G. S., Jun.—*We have inserted the communication respecting his invention. Some of our readers may, perhaps, make application, or give information on the subject. At the same time, if he will forward an explanation, we shall be happy to give our opinion.*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of al Booksellers and Newsmen in Town and Country

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 65, THIRD SERIES. } SATURDAY, FEB. 5, 1842. { No. 313, OLD SERIES.

BILBROUGH'S AIR-PUMP.

Fig. 1.

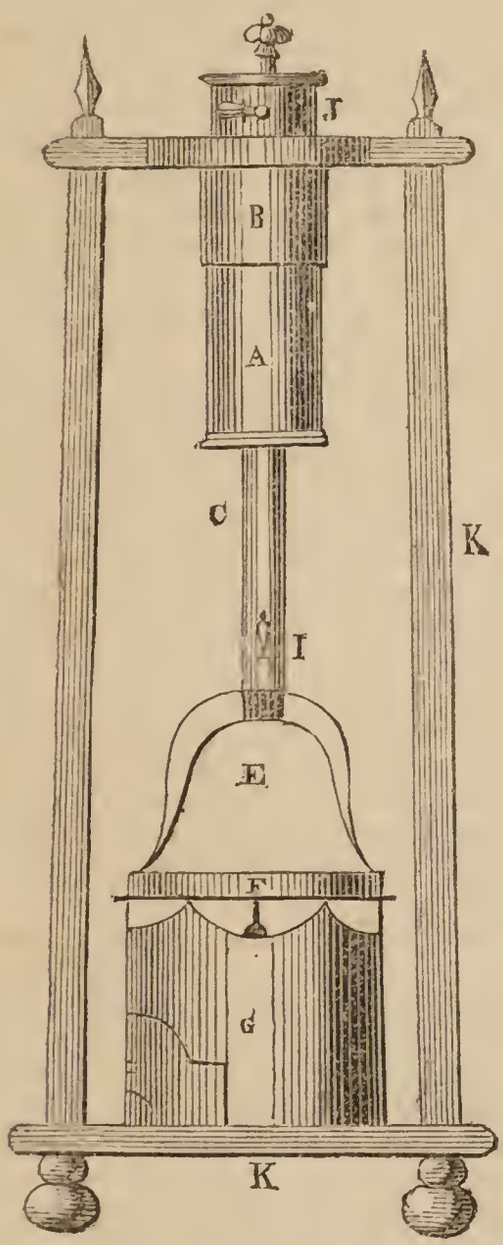
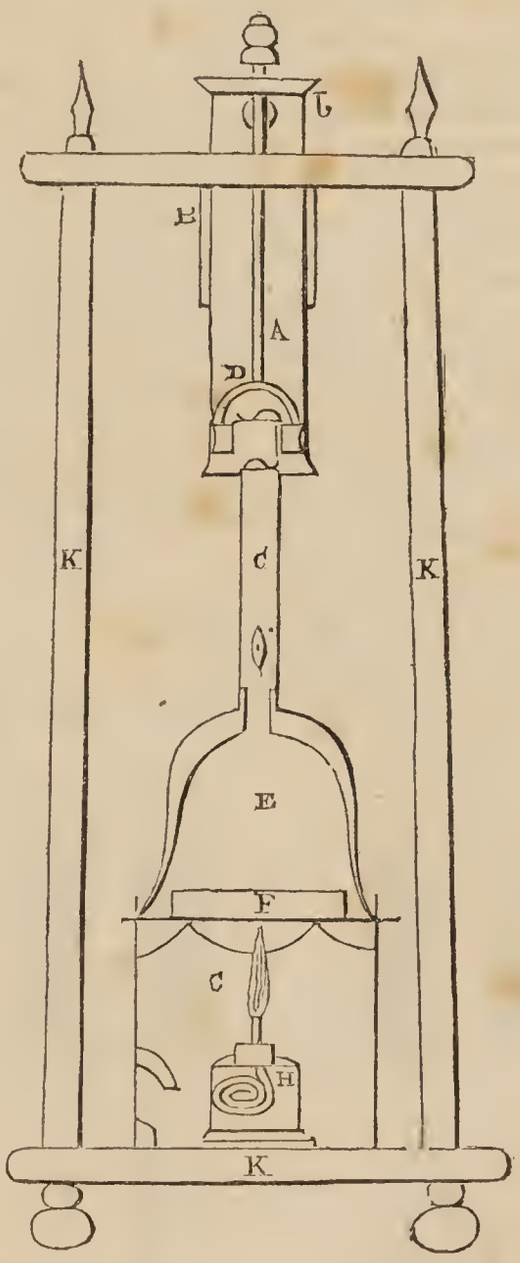


Fig. 2.



Vol. VIII.—No. 6.] [City Press, 1, Long Lane, Aldersgate Street: D A. Doudney.

BILBROUGH'S AIR-PUMP.

To the Editor of the Penny Mechanic and Chemist.

(See Engraving, front page.)

Sir,—I herewith send you a description of an air-pump I have invented, which, if you think it worthy of insertion in your useful Magazine, is at your service.

The air-pump I have constructed, is intended to produce a more perfect vacuum than can be produced by any other air-pump that is in use. The air is exhausted from the receiver by raising the piston; while the throttle-valve remains open, the air will rise from the receiver to the syringe; when depressing the piston, the air is prevented returning, by the valve closing; when the air, that was beneath the piston, escapes through the valve contained in the piston, and is drawn to the top of the syringe, where it is liberated at the escape-valve. Repeat the working of the piston until the air is nearly exhausted; then ignite the cotton of the lamp, which will rarify or expand the air that is left in the receiver, when repeating the working of the piston, and close the throttle-valve every other time the piston is raised; a nearer approach to a vacuum can be obtained, than by any other pump in use—at least a perfect vacuum could be obtained, were it not for the external pressure of the atmosphere upon the escape-valve.

Description of the Engravings.

Fig. 1 is an exterior view.

Fig. 2, the interior view.

Fig. 3, a section of syringe-pipe, with the valve open.

Fig. 3. Fig. 4.

Fig. 4, ditto, with valve closed.

A, the syringe; B, spring slide; C, syringe-pipe, containing throttle-valve; D, piston, containing a valve; E, receiver; F, grease-holder; G, lanthorn; H, lamp; I, throttle-valve; J, escape-valve; K, frame of air-pump. The description answers the same letters to all the diagrams.

I remain yours, &c.

T. R. Bilbrough.

DESCRIPTIVE GEOLOGY.

(Continued from page 37.)

EOCENE PERIOD.

The first series of deposits belonging to the tertiary periods, of which the characters were accurately determined, were those which occur in the neighbourhood of Paris; first described by MM. Cuvier and Brongniart, in the "Environs de Paris," 1811. It appears that that capital "is situated in a kind of trough of vast dimensions, formed by chalk hills rising around it on every side; and in that hollow there is a vast accumulation of tertiary strata. From the form of the country, this deposit has been called the 'Paris basin.' It is about 180 miles, in a direction from N.E. to S.W., and ninety miles from E. to W." It affords one of the most remarkable instances to be met with, of the various vicissitudes to which the surface of the earth has been subjected. There are three *fresh-water*, and two *marine* deposits, which alternate with each other; the former composing the first and the last of the series. The general arrangement is as follows (order ascending):—

1st. Fresh-water formation. This has been divided into plastic clay, lignite, and first sandstone. Plastic clay was so named, from its easily receiving and preserving the forms given to it; and, from possessing this property, it is used in the potteries.

2nd. First marine formation. Calcaire grossier, or coarse limestone, abounds in marine and fresh-water shells, containing portions of palm trees, as well as others of the dicotyledonous class. It is frequently separated from the plastic clay by a bed of sand, and it alternates with argillaceous beds.

3rd. Second fresh-water formation. Consists of siliceous limestone, gypsum, and fresh-water marls. The colours of the gypsum are grey, white, and yellow. The gypseous strata contain the remarkable remains of several extinct species of mammalia. Fishes, birds, and reptiles, have also been discovered in them.

4th. Second marine formation. Consists of sandstone, generally white, or

partially reddened or ochraceous, and but slightly aggregated, except at Fontainbleau.

5th. Third fresh-water formation. Millstone without shells, shelly millstone, and marls. The latter contain seeds and vessels of aquatic plants (charæ).

By a singular coincidence, London is built on clays, sands, and shingles; also filling up a basin of the chalk, which skirts the area of the tertiary strata on the S., but is open to the sea on the E.; the Isle of Sheppey, situated in the mouth of the Thames, being an outlier of the same deposit. It spreads over Essex, a considerable part of Suffolk, Epping, and Hainault forests, the whole of Middlesex, and a portion of Bucks. It is bounded on the S. by the N. Downs; extends on the W. beyond High Elm Hill, in Berks; and on the N.W. is flanked by the chalk hills of Wilts, Bucks, Oxon, Berks, and Herts. In the immediate vicinity of the metropolis, a stiff clay, of a bluish colour, abounding in marine remains, constitutes the great mass of the materials which fill up this ancient gulf of the ocean.

This clay is known by the name of "London clay." It is very variable in thickness; at Bromley, near the Lea, in the S.E. corner of Middlesex, it was found to be only forty-four feet thick; while at White's Club House, St. James's, London, it was 235 feet. "This clay is altogether unfit for arable cultivation, until its nature is altered and corrected by the addition of chalk, lime, and ashes"—*Agriculture of Midd'esex*, 15th vol. *Penny Cyclop.*

In Hants, a series of contemporaneous deposits, but with intercalations of lacustrine beds, in like manner occupy a depression in the chalk, and constitute the "basin of the Isle of Wight." We are indebted for the discovery to Mr. Webster, a veteran geologist.

Organic Remains of the Eocene Period.

In the first great fresh-water formation, nearly fifty extinct species of mammalia have been discovered by Cuvier; the greater number of these (four-fifths) belong to the following extinct genera, in the order pachydermata—viz. palæotherium, anoplotherium, lophiodon, anthracotherium, chœropotamus, adapis. The discovery and definition of these pachydermic forms, now utterly swept away from the face of the globe, form one of the noblest triumphs of the great French zoologist, who, from confused fragments, huddled together pell-mell, separated the different bones, and, so to speak, gradually built up the frame-work of the lost animals, till their osseous structure and place in the chair of created beings, became as well known as those of the animals that dwell upon the earth at the present day.

Among the reptiles are trionyx, emys (several species), crocodilus.

There have been found ten extinct species of birds. In this small number of species we have seven genera; and these afford examples of four, out of the six great orders into which the existing class of birds has been divided by Cuvier—viz. accipitres, gallinaceæ, grallæ, and palmipedes. Even the eggs of aquatic birds have been preserved in the lacustrine formations of Cournon, in Auvergne.*

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS, &c.

(Concluded from page 36.)

It is a matter of regret, that the constituent proportions of steel have not been determined with the same precision. Vauquelin affirms the average amount of carbon to be $\frac{1}{150}$; and Clouet places it as high as $\frac{1}{32}$. Mr. Parkinson† observes, "The quantity of carbon necessary for making of steel, is very small indeed; the amount actually existing in steel, seldom exceeding $\frac{1}{200}$ or $\frac{1}{300}$, and, perhaps, never more than $\frac{1}{100}$; the remaining portion of charcoal flying off, at the time of cementation, in the form of gaseous oxide of carbon;" possibly, the dose of carbon may be, in some measure, regulated by the quality of the iron—as we know every description of iron is not alike suitable for being converted into steel; that from the Danemora mines, in Sweden, produces the best; and this iron is made from a magnetic iron ore.

Dr. Thomson analysed some specimens of cast steel from the manufactory of Mr. Buttray, near Glasgow, and the general results of his trials gave the constituents as follows:—

Iron	99
Carbon, with some silicon	1
	100

Now this approaches

---

* The eggs of turtles are daily in the course of fossilization on the shores of the Isle of Ascension.

† "Chemical Pocket-Book," p. 147.

Iron, 20 atoms	70
Carbon, 1 atom....	0.75
	70.75

And this Dr. Thomson considers as likely to be the constitution of cast steel. He did not in like manner attempt to determine the constitution of blistered steel, and concludes the proportion of carbon in it to be rather less. Yet, if we can rely on the analyses of several kinds of steel, published by Vanquelin in 1797, we must admit, that its composition is nearly identical with cast steel. Vanquelin obtained, stating the maximum, from 100 parts of steel,

Iron	97.597
Silica	0.315
Carbon	0.789
Phosphorus....	1.520

Now, if we convert silica into silicon, and add it to the carbon—considering phosphorus an accidental ingredient—the carbon will amount to nearly one per cent., which is precisely its proportional value in cast steel.

The simple fact that steel is composed of iron combined with pure carbon, and not charcoal, has been demonstrated by the experiments of Clouet, and, more lately, by Stodart, founded on the researches of Guyton-Morveau, on the carbonic nature of the diamond. The process may be briefly described:—A diamond, together with some iron filings, was placed in a cavity bored in a block of soft iron, and the orifice carefully secured by a plug of iron; the whole was then enclosed in a crucible, and exposed to the heat of a blast-furnace. The result was, the diamond had disappeared, the metal was fused, and converted into a button of cast steel.

Mr. Mushet, whose authority on this subject is of great weight, concluded, from some experiments he made, that the diamond did not contribute the carbon; for, on omitting the diamond, the conversion took place, as he imagines, from carbon, dissolved in caloric, penetrating through the crucible.* This opinion, however, evidently fallacious, was controverted by Sir George Mackenzie, who repeated the experiments of Guyton-Morveau, and with complete success.†

From the preceding details, adopting the language of Dr. Thomson, "It is obvious that iron and carbon are capable of combining together in a variety of different proportions; when the carbon exceeds, the compound is carburet of iron; when the iron exceeds, the compound is steel or cast iron, in various states, according to the proportion. All these compounds may be considered as *sub-carburets of iron*." The most complete detail of experiments on these various compounds, which has appeared in this country, are those of Mr. Mushet,* published in the "Philosophical Magazine." This ingenious practical chemist has observed, that the hardness of iron increases with the proportion of charcoal, with which it combines, till the carbon amounts to about one-eightieth of the whole mass. This hardness is then a maximum; the metal acquires the colour of silver, loses its granulated appearance, and assumes a crystallized form. If more carbon be added to the compound, the hardness diminishes in proportion to its quantity. The following table,† by Mr. Mushet, exhibits the proportion of charcoal which disappeared, during the conversion of iron to the different varieties of subcarburets known in commerce:—

- $\frac{1}{120}$ soft cast steel.
- $\frac{1}{100}$ common cast steel.
- $\frac{1}{90}$ the same, but harder.
- $\frac{1}{80}$ the same, too hard for drawing.
- $\frac{1}{25}$ white cast iron.
- $\frac{1}{20}$ mottled cast iron.
- $\frac{1}{15}$ black cast iron.

It will be seen, that these results do not altogether agree with those obtained by Dr. Schafthaeutl, whose paper on "The Relative Combinations of the Constituents of Cast Iron, Steel, and Malleable Iron," appeared in the PENNY MECHANIC, vol. 5, p. 129. With regard to steel, the general proportion of carbon is nearly the same; but the Doctor detected *manganese*, *arsenic*, *antimony*, *sulphur*, and *azote*, in the specimen he analysed, said to be a fragment of a razor forged in the workshop of Mr. Rodgers, of Sheffield, the specific gravity of which was 7.92. That these ingredients, if common to steel, should have escaped the research of former chemists, is somewhat extraordinary, and not easily accounted for; particularly as cast steel is used in the fabrication of razors. Had the blistered variety been taken, there would have been more room for rational conjecture.

Dr. Schafthaeutl propounds a novel and

* "Philosophical Magazine."

† "Nicholson's Journal," June, 1809.

* "Philosophical Magazine," vol. xiii., p. 138. I do not include Mr. Mushet's late work, intituled, "Papers on Iron and Steel, Practical and Experimental," 1 vol., roy. 8vo., which I have not yet had an opportunity of consulting.

† Id., xiii., 142.

startling theory, some parts of which deserve the most rigid examination, inasmuch. that the Doctor's propositions tend to solve some of the most difficult problems in mechanical philosophy. It is stated as an ascertained fact, 1st. "That the molecules of the iron are arranged in grey cast iron in the most regular form, having all their surfaces in one plane. But the most equal distribution of molecules appears in hardened steel; collecting in fascicular aggregation in soft steel, and being loose and longitudinally arranged in wrought iron. 2nd. That pure iron cannot be welded; the welding power of the iron depending on its alloy with the carburet of silicon; and, farther, that the good and various qualities of all the wrought irons, depend on the alloys of pure iron with other metallic bodies. 3rd. That steel is an entirely mechanical production of the forge-hammer, which tears the molecules of certain species of white cast iron out of their original position; into which the forces of attraction, in respect to the centres, as well as to the position of the molecules, had arranged those molecules by the slow action of heat; and that steel, as it comes out of the converting furnace or the crucible, is nothing more or less than white cast iron, of which Indian steel, called *wootz*, is the fairest specimen."

Such are the ingenious deductions of Dr. Schafthaeutl, which, if proved by repeated experiments, will serve to explain many of the known, but hitherto unaccounted-for, properties of iron and steel.

The problem so important to machinists, whether cast steel can be welded to iron, has never, I believe, been satisfactorily solved. I have witnessed, at least, a score of attempts, all of which terminated unsuccessfully. I am aware that cast steel may be united to iron, by the intervention of some flux; but this is soldering, not welding. Now the difficulty arises from a peculiar property inherent in cast steel; it will not endure a welding heat, or, at all events, it disperses under the blow of the hammer at that heat. I find it stated by Sir Thomas Frankland,* that cast steel, in a *white heat*, and iron in a *welding heat*, unite completely; and I have been lately assured, by an intelligent workman, that lime,† slaked by the action of the atmosphere, and spread over the incandescent surface of the steel, enables it to bear the requisite heat for welding. The greatest discovery of modern date, with regard to the treatment of cast steel, is that of Mr. Perkins. This eminent mechanic first decarbonizes the metal, and then reimparts the proper dose of carbon, by a process similar to case-hardening. I have applied this method in the preparation of some portions of delicate machinery, where I wished to have the working parts of cast steel hardened, and the remainder of pure iron. I beg to refer such of your readers as may wish to see a full account of Mr. Perkins's process, to the "Engineer's and Mechanics' Encyclopædia," vol. i., page 475.

* "Philosophical Transactions," 1795.

† I find Dr. Ure states, that the common way to soften steel is, to put it into an iron case, surrounded with a paste made of *lime*, cow's gall, and a little nitre and water; then to expose the case to a slow fire, which is gradually increased to a considerable heat, and afterwards allowed to go out, when the steel is found to be soft, and ready for the engraver.—*Dictionary of Arts and Manufatures*—Art. *Steel.*

LATHE COLLARS.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I have to thank "An Amateur Mechanic" for his examination of the merits of an arrangement for lathe collars, a description of which I sent you. That arrangement was not my own, but I had received it from another, and gave it as the best of which I knew. Till I read your correspondent's remarks, I had not especially turned my attention to the subject of lathe collars; but his communication has induced me to do so, and the results of my considerations I beg leave to present to your readers.

Collars, formed of two parts, are most advantageously applied, where the mandrel is double-nosed, or has both collets the same size; and where light materials are turned, the friction being equal on both collars, both will wear equally. Conical collars are calculated for mandrels with a back screw, to keep them up to the front collar. The arrangement mentioned by your correspondent in page 341 of the last volume, is exceedingly ingenious, and obviates the general objection to conical collars—viz. that they are not fitted for lathes in which there is a left-hand nose to the mandrel, inasmuch as there is no means of tightening them.

Friction in collars is caused, first, by the pressure of the collet against the collar endwise; secondly, by the weight of the material turned; and, thirdly, by the

pressure of the tool against the material. The first cause produces more mischief in those lathes which have a divided front collar, with a screw centre at back; the top of the collar being screwed down as it wears, in order to prevent shake, causing the mandrel to lose its parallelism; the nose falling nearer to the bed of the lathe, while the back centre remains at the same distance as before. The same kind of effect is produced by the second cause—viz. the weight of material turned, with one distinctive feature, the mandrel becomes a lever, of which the collar is the fulcrum; consequently, the back centre or collet bears against the upper part of the bearing, and causes that to wear. The third cause operates most in light turning, throwing the mandrel against the side opposite to the tool.

All lathes are, more or less, subject to these causes and effects of friction; and, therefore, it is desirable to ascertain the best material and shape for the collars and collets. I am sure that "An Amateur Mechanic," from the candour which he shows, will excuse me if I profess my inability to believe the statement of Mr. Hicks respecting his lathe; for if it were true that it had been in use fourteen years, and was then in as good condition as when new, surely that lathe would possess the desired requisite, and we should have to search no farther.

The mandrel with shifting cone, mentioned by your correspondent in page 344, is the best which I have yet seen; but I think it is still capable of improvement. The means of adjustment being at the back of the mandrel, it follows (pressure being exerted on the front, the solid cone there placed will wear most) that, as the back cone is screwed up, it will draw the mandrel farther back, and thus change its position longitudinally, which will be inconvenient, if there be gearing or other machinery attached. I propose, therefore, to make both cones to shift; and, as this would cause an inconvenient length in the nose, if placed outside the popit, I would place them both inside, between the collars, with screws of equal pitch, so that each being moved the same distance when required, would preserve the mandrel and affixed gearing in one position.

I remain yours, &c.,

W. H.

P.S. As I am about to construct a new lathe for my own use, I shall be exceedingly obliged to "An Amateur Mechanic," or any other of your correspondents, for any information on the subject.

To the Editor of the Penny Mechanic and Chemist.

Sir,—The hydro-pneumatic lamp, of which I sent you a description, you were pleased to insert in No. 4 of your valuable Magazine; but you have made it appear as "Starkey's Hydro-pneumatic Lamp;" leaving the reader to imply, that the idea originated from me. Such not being the case, I shall feel obliged by its being corrected in your next Number.

I remain yours, &c.,

G. Starkey,
Mineralogical Chemist.

MISCELLANEA.

Combustion of Iron by Sulphur in Vapour.—Heat some sulphur in an iron gun-barrel, the touchhole of which is plugged, and whose mouth is closed with cork having a piece of glass tube, about one-thirtieth of an inch in diameter, inserted in it. A bunch of iron wire, if exposed to the jet, burns in the same manner as in oxygen, and sulphuret of iron is formed.

A Pyrophorus may be formed by heating tartrate of lead in a glass tube. When a portion of the ignited tartrate is taken out of the tube, it almost instantly takes fire, and burns for a considerable time.

A. Y. C.

To make a Cheap Spirit-Lamp.—A very cheap and useful spirit-lamp may be formed, by procuring a two-ounce *widemouth*; to the mouth of which, fit accurately a sound cork, having another smaller cork inserted in it, and projecting about half-an-inch beyond the larger cork. The spirit-lamp is then complete; but, as it is frequently desirable to keep the alcohol in the lamp, in order to avoid the trouble and waste of constantly pouring it back into the bottle, I propose that a small bottle be procured, the body of which is about the size of the smaller cork; the neck and shoulders are then to be taken off, by running a heated iron round it; and, while it is still warm, plunge it into water; a crack will then be formed in the part which was heated, and, by the repeated application of the heated iron, it may be extended all around; and if, when the lamp is not in use, the cap be placed over the cork, it will effectually prevent any waste of the spirits. I have constructed one, and find it equal, in practical utility, to the 3*s.* glasses now in use.

A. Y. C.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, Feb. 9, W. H. J. Traice, Esq., on the Genius and Dramatic Writings of Richard Brinsley Sheridan. Friday, February 11, J. Hemming, Esq., on Chemistry. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, February 10, William Jones, Esq., on Insects. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Feb. 7, A Concert by the Members. At half-past eight.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, Feb. 6, Mr. Dart, on Crime. At eight o'clock.

QUERIES.

How to make copying-ink, and to keep ink from moulding? A. BRAND.

The exact proportions for making wax crayons or creta levis? Also, the way to grind a glass lens for optical instruments; and whether the glass is flint or plate? H. B.

I find the steam of water, when passed through a red-hot iron tube, becomes decomposed, the iron becomes oxidized, and hydrogen is disengaged; I wish to know if there is any strong metal that will stand heat and not decompose the steam of water, so that the metal shall not be oxidized therewith. J. S.

How to make canvass impervious to rain?

Which are the best and cheapest drop-lights for outside a shop-window, and where can I purchase them? W. S.

The best method of cutting porcelain, and drilling holes in the same? Also, the cheapest method to obtain alumine from alum, by precipitation or otherwise? What varnish, bronze, or paint, will stand a heat sufficient to melt lead? T. M. R.

"G. R." will give half-a-guinea to be practically instructed in the use of the still. Any subscriber, having apparatus, accepting the offer, their address will oblige, G. R.

How to construct the small tin pipes used in a small organ called the *bird-organ*, and how to tune them. If there are any pipes less difficult to make and tune, I should like to know their construction? W. R L.

Some time since I resided in the country, where I had frequent occasion for the use of a theodolite; having removed to town, and not being likely to require it again, I should be happy to dispose of it. If any of your numerous readers should be in want of one, they will find this an opportunity worth embracing. It is fitted up with cross sights, vernier, spirit-level, compass, &c., and enclosed in a mahogany box. It is as good as new, and the name of its maker (Dolland) will vouch for its goodness. The cost price was six guineas, and will be sold cheap. A line, addressed, "A. B., 86, Post-office, Boston Street, Hackney Road," would meet with attention.

Do the posture-masters use any oil to rub their joints with; if so, what oil? B. A.

How much carbonic acid does a man generate per hour? What are the ingredients put into glass to make it of various colours? What causes hats to turn rusty at the sea-side? A. S.

Does a polished surface radiate heat, or merely reflect it? I am aware a blackened or rough surface absorbs heat, while a bright one retains it (as seen in the case of a black teapot and a bright metal one); but I do not know whether it (the bright one) would give out heat unless it be touched. Or, to put the question in another form, would greater heat be felt in a shop warmed by an Arnott stove, if the outer surface were made bright, instead of being left black, as it generally is? E. F. B.

"G. S., Jun.," having given a scale for making the pipes, in his anatomy of the organ, he would greatly oblige me if he would give me, through the medium of your valuable pages, a scale for the reeds; I mean the vibrating tongues. Also, can any of your correspondents inform me, where I could get six or eight brass wheels cut; they are from two to four inches in diameter, three-eighths thick, and about the price of them? J. R. B. H. K.

ANSWERS TO QUERIES.

"A. B. C." The cheapest place in London for electrotype apparatus, is Jones's, 23, Harp Alley, Farringdon Street. O. S.

Composition Candles.—The public are not generally aware, that in most composition candles (I may say without exception), arsenic is used. It is said that it whitens, but this is not the object in using it, but to break the grain; without which, the material would crack, and, in some cases, scarcely hold together. Some experiments have been made with bismuth, under which name arsenic is generally used. The result of this experiment I doubt being good.

T. FULLER, Jun.

To ascertain the Purity of Gold without the aid of Chemistry.—The circumstance of any solid body displacing its own bulk of liquid, and losing as much of its weight as the weight of that bulk of liquid which it displaces, has led to the use of the hydrostatic or water-balance, for ascertaining the intrinsic value of gold and other precious metals. For example; by knowing, in the first place, how much water a pound of pure gold displaces, and then weighing in water an object said to be a pound of gold, we should observe whether it displaced the proper quantity of water; if it displaced more than was proper, then we should be certain that it contained alloy or some inferior substance, being too bulky for a pound of gold. Such weights are used by goldsmiths. Thus, if a piece of gold weigh $19\frac{1}{3}$ ounces in air, it would weigh $18\frac{1}{3}$ ounces in water; the ounce of weight thus counteracted, being just the weight

of the water that the gold displaces. Therefore the weight of the gold would be to that of the water, as 19½ ounces to 1 ounce—that is, the specific gravity of gold is 19½ ounces, if water is taken for the standard... *Hydraulics.* P. S.

To Preserve Steel from Rust.—A thin coating of caoutchouc is an excellent preservative of iron and steel articles from the action of the air and moisture. The caoutchouc must be melted in a close vessel, that it may not inflame, nearly at the temperature of fusing lead, and must be stirred to prevent burning. Mix some oil of turpentine with the caoutchouc, which will render it easily applicable, and leave the substance, when dry, as firm as varnish, and impervious to moisture. This may easily be removed, when required, by a soft brush dipped in warm oil of turpentine.

J. Gibbs.

The Weight of a Cubic Foot of Water is 1000 ounces, and a cubic foot of air weighs one ounce and a quarter. Water, at its ordinary temperature of 62°, has a specific gravity of 1000 ounces to the cubic foot. Platinum is 22½ times heavier, or 22½ times the specific gravity of water; gold is 19½, mercury 13½, copper 8¾, iron 8, common stone about 2½, and brick 2. Alcohol is a little more than eight-tenths of the heaviness or specific gravity of water, and oil of almonds is a little more than nine-tenths. Sea-water generally possesses a specific gravity of 1.035—that is, to 1000 parts of fresh water, there are, in addition, thirty-five parts of saline substances. This is given only as a general rule, the sea not being uniformly salt. Sea-water being, therefore, thirty-five parts for every 1000 of water more dense than fresh water, it possesses a proportionally greater power of buoying up bodies; therefore, a vessel which will carry 1000 tons on fresh water, will thus carry 1035 tons on the sea. P. S.

"W. H." From some accidental omission, I have not received Parts 11 and 12 of the Penny Mechanic; I am, therefore, at a loss to conjecture to what he alludes in his note addressed to me in No. 61. I am just what I have represented myself to be, an *amateur* mechanic, and, as such, at all times happy to be instructed by the *practical artisan;* yet I imagine, if "W. H." will do me the honour to read with attention the papers I have contributed on steel (see pages 2, 10, 20, and 26, of the first four Numbers of this year's Mechanic), he will admit that I, at least, have not sacrificed practice to theory. In No. 63, p. 26, he will find I have expressly stated, that, under certain circumstances, tools made of cast steel, do not require letting down; this, be it remembered, is the exception, not the rule; for surely "W. H." would not recommend slide rest tools or cutters to be left "perfectly hard!" Experience is, doubtless, a very valuable thing, but sometimes fallacious; since one man, from a natural aptitude may, and oftentimes does, acquire more knowledge of a mechanical art in one month, than another can in one year; and yet both may possess equal abilities, though of entirely different capacity. I am aware that workmen are too apt to contemn the non-professional, forgetting that many of the most important mechanical improvements and applications have originated from amateurs. I shall consider myself under an obligation to "W. H.," if he will explain, through the medium of this Journal, the process he adopts, describing the stove for hardening tools; as, I fear, the distance I reside from the Metropolis, precludes a personal interview.

To Weld Cast Steel.—It is generally supposed, and, I believe, correctly, that cast steel cannot be welded either to itself or iron; but it may be decarbonized, then united, and afterwards reconverted, by cementation, into steel. I would recommend to the notice of mechanics, a treatise by M. Damemme, intituled, *Essai Pratique sur l'emploi et la maniere de travailler l'acier*, 18mo. It is well worth translating for the use of many, who do not understand the French language.

To Anneal Cast Iron.—Cast iron is annealed by extracting or burning out as large a quantity as possible of the superabundant carbon with which it is charged. This is effected by placing the article in an open fire, and allowing a free access for the atmosphere. The theory in which this process is founded, depends, I believe, on the known affinity which oxygen has for carbon. Thus, common articles of cutlery of cast iron, are stratified with some substance containing oxygen—as poor iron ore, free from sulphur—and kept in a state little short of fusion from eighteen to twenty-four hours, which renders them, to a considerable degree, malleable.

I shall feel greatly obliged to "W." for a description, with drawings, of the rotary steam engine, which he is so kind as to offer. The Editor of the Penny Mechanic will take charge of, and forward the same to,

A. M.

TO CORRESPONDENTS.

W. H.—*With every respect for our correspondent we must decline inserting any more letters on the subject of the late accident on the Great Western Railway; it would involve needless controversy.*

To make Hungary Water—*Take of oil of rosemary, two drachms; rectified spirit, one pint. This is the nearest imitation. The genuine is imported.*

S. M.—*We believe that no method which has been tried for killing quicksilver has succeeded. Turpentine acts as a solvent, but its smell is objectionable, and trituration is universally employed. The wholesale chemists triturate by means of steam.*

J. Fuller, Jun.—*His article on glass-blowing appeared in No. 33, New Series, July 17.*

Errata.—In Nos. 58 and 59, page 159, for "On Steel and the Mode of Preparing it for Tools," read *On the best Form and Material for Cutters of a Lathe Mandrel.* In No. 63, p. 28, for "570°," read 470°; for "420°," read 190°.

London: Printed at "The City Press," 1, London Lane, Aldersgate, by D. A. Doubleday (to whom Books for Review and all communications for the Editor must be addressed, postage paid), published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

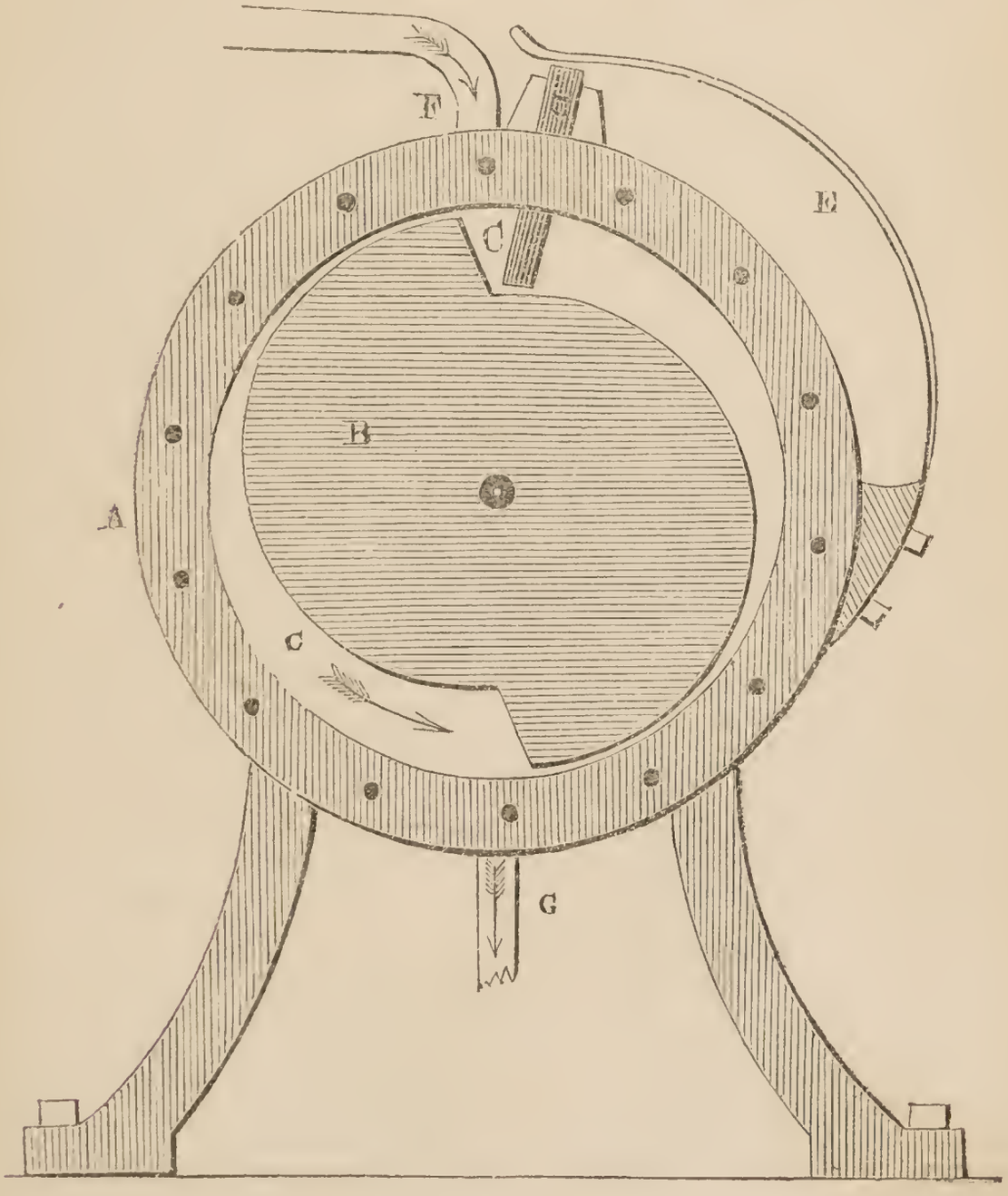
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 66, THIRD SERIES. } SATURDAY, FEB. 12, 1842. { No. 314, OLD SERIES.

HAMMOND'S ROTARY ENGINE.



Vol. VIII.—No. 7.] [City Press, 1, Long Lane, Aldersgate Street: D A. Doudney

HAMMOND'S ROTARY ENGINE.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—Having been studying a little on the rotary engine, and considering the above a very good one, I send you the plan. If you think it worth notice, I shall feel obliged by your inserting it in your valuable work.

Description of the Engraving.

A, the outer box, which is stationary, with the end or side plate off, showing the inside.

B, the inner box, which revolves.

C C, the steam-way.

D, a sliding plate through the outer box.

E, a spring, to keep the sliding plate close to the inner box; while revolving, the steam enters at F, and makes its exit at G, whereby a rotary motion is obtained, without compressing the steam again in the engine, before it can make its escape, which is the case in most of the rotary engines.

R. Hammond.

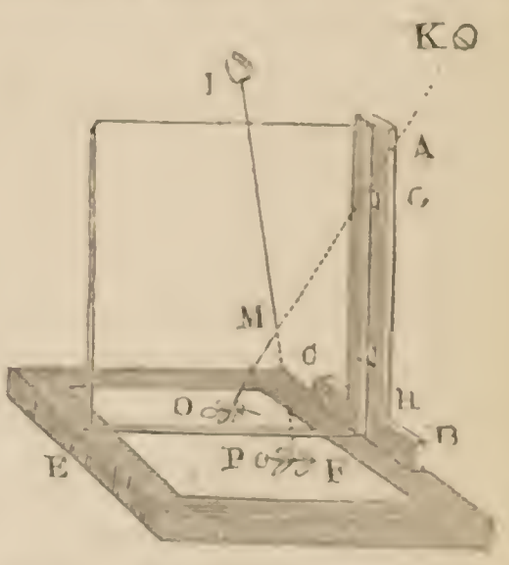
[As the subject of the rotary engine is one which is likely to become of very general interest, from its simplicity and smallness of cost compared with those of the usual construction, we give insertion to Mr. Hammond's description, and shall, in future, take every opportunity of turning the attention of our readers to this valuable improvement; hoping to draw out from men of real practical experience, whatever suggestions may arise in their minds respecting it.—Ed.]

A SIMPLE CAMERA LUCIDA

Has recently been invented by Sir John Robinson, Ex-secretary to the Royal Society of Edinburgh. This camera is remarkably cheap, easily constructed, and peculiarly applicable to the delineation of fruits, flowers, bulbs, seeds, and other small objects. It was exhibited to the Edinburgh Society of Arts on March 8th, 1811. "Something similar," Sir John Robinson observes, "was suggested to me, some years since, by the Rev. Mr. Taylor, of York; but it had escaped my memory until lately, when, looking at some plants confined in a frame of plate glass, I was struck with the vivid images of the plants reflected from the bright plates, at such an angle, as permitted vision of objects through them. This recalled Mr. Taylor's suggestion, and showed me how it might be made available for copying natural flowers and other small objects."

The figure represents a piece of thin plate glass, A D E F, set upright on a drawing-board, by means of a wooden standard, A B C, in a groove, in which (the plate), as at M, a distinct image of the object, O, will be perceived, as if it lay on the paper at P; and as, at the same time, a pencil, held on the right-hand side of the plate, will be equally visible, it may be applied to trace the image at P.

Some attention is required in selecting a favourable position for the apparatus, in



respect to the illumination of the object, and its admitting only such a degree of light to the paper, on the right hand side of the glass, as may give sufficient distinctness to the point of the pencil; by which precaution, the reflected image is seen to most advantage.

It must be recollected, that the delineation will not represent the original object, as beheld by direct vision, by an eye placed at I, being that of a reflected image—similar to what would be seen by direct vision, if the eye had been situated at K.

CHARACTER OF ENGLISH AND FOREIGN ARTISANS.

No. II.

The effects of the deficiency of education are most strongly marked in the Italians, who, with the advantage of superior natural capacity, are of the lowest class of workmen; though they comprehend clearly and quickly any simple proposition made, or explanation given to them, and are enabled quickly to execute any kind of work when they have seen it performed once; yet their minds, from want of development, by training or school education, seem to have no kind of logic, no power of systematic arrangement, no capacity for collecting any series of observa-

tions, and making sound inductions from the whole of them. This want of the capacity of mental arrangement, is shown in their manual operations. An Italian will execute a single operation with great dexterity; but, when a number of them are put together, all is confusion; they cannot arrange their respective parts in a complicated operation, and are, comparatively, inefficient, except under a very powerful control. For example; within a few years after the first introduction of cotton spinning in Naples, in the year 1830, the spinners produced twenty-four hanks of cotton yarn, from No. 16 to 20, per spindle, which is equal to the production of the best English hands; and yet, up to the present time, not one of the Neapolitan operatives is advanced far enough to take the superintendence of the operations of a single room, the superintendents being all northerns, who, though much less gifted by nature, have obtained a higher degree of order or arrangement imparted to their minds by a superior education.

To the question, "What are the characteristics of the Scotch?" the following reply was given:—"We find that they get on much better on the Continent than the English, which is to be ascribed chiefly to their better education; which renders it easier for them to adapt themselves to circumstances, and especially in getting on better with their fellow-workmen, and all the people with whom they come in contact. Knowing their own language grammatically, they have, comparatively, good facility in acquiring foreign languages. They have a great taste for reading, and always endeavour to advance themselves in respectable society; which makes them careful of their conduct, and eager to acquire such knowledge as may render themselves acceptable to better classes."

The Dutch workmen are, like the English, quite specially trained, and their education is not of a very high order, but very sound, and decidedly superior to the English. It is an education in which economy, domestic and public respectability of conduct, are particularly enforced. They are, almost invariably, particularly honest, economical, orderly, and trustworthy men.

While, in respect to the work to which they have been specially trained, the English workmen are the most skilful; they are, in conduct, the most disorderly, debauched, and unruly, and least respectable and trustworthy of any nation employed on the Continent. These characteristics of depravity do not apply to the English workmen who have received an education, but attach to the others in the degree in which they are in want of it. When the uneducated English workmen are released from the bonds of iron discipline in which they have been restrained by their employers in England, and are treated with the urbanity and friendly feeling, which the more educated workmen on the Continent expect and receive from their employers, the English workmen completely lose their balance; they do not understand their position, and, after a certain time, become totally unmanageable and useless. The educated English workmen, in a short time, comprehend their position, and adopt an appropriate behaviour.

(To be continued.)

ON THE DIVIDING PLATE TO LATHE PULLEY.

To the Editor of the Penny Mechanic and Chemist.

Sir,—The inconvenience and loss of time resulting from the use of the common dividing plate attached to the lathe pulley, led me, some years ago, to consider whether some better mode for obtaining the same end could not be devised; other and more serious occupations interrupted the design I had then in hand, and it is only very lately that a passage I met with in "Emerson's Principles of Mechanics,"* has induced me to resume the inquiry; particularly as I find a similar plan for circular division, to that I had proposed to myself, there recommended. Without farther preface, then, I would suggest, instead of a dividing plate, with concentric circles of fixed divisions or holes, that a wheel be keyed on the mandrel of the lathe, the edge of which must be cut into any determined number of teeth—300 or 400—of a suitable form and inclination to take into the thread of an endless screw; and, I think, it would be advisable to arrange matters so, that a *known* number of turns of the screw round its axis, should cause the wheel to perform *one* revolution. Suppose the wheel to have 300 teeth, and let 300 turns of the screw cause the wheel to revolve once, it is evident that *one entire* turn of the screw would be equivalent to the distance between any two of the teeth; or, what is the same thing, it would move the screw round $\frac{1}{300}$th part of its circumference. In

* Edit., 1825, p. 311.

like manner, any number of turns of the screw would move it a proportional part. By this means, any even number, which is a multiple of 300,* may readily be obtained. For instance, suppose it is required to divide a plate into fifty equal parts, or to cut fifty teeth in a wheel, we divide 300 by 50, and the quotient, 6, indicates the number of turns of the screw which are requisite to move the wheel forward a space sufficient for one tooth; but, as odd numbers are frequently occurring in practice, it will be seen that this mode is quite as capable of dividing a circumference into any number of *odd*, as into *even* parts. In the first place, it will be necessary to have what, I believe, is termed a micrometer head, affixed to the screw, which head must be divided into any convenient number of equal parts†—say 100, and an index or stop so placed, that we may be enabled to ascertain the exact number of turns, as well as fractional parts of a turn, we may give to the screw, the utility of which will become apparent as we proceed. Now, suppose we have to cut *fifty-six* teeth in a wheel, we commence, as before, by dividing 300, or whatever the number of teeth may be, of the dividing wheel, by the number to be cut, in this case 56; this operation gives nearly 5.35 (about $5\frac{3}{8}$)‡, which shows, that for each tooth the screw must be turned round *five* times, and *thirty-five* parts of the 100 into which the micrometer head is divided. By this method, almost any odd number of teeth may be cut, or equal parts defined, both with accuracy and despatch; but, as some mechanics may be indisposed to reject the plate with which long usage has made them familiar, I shall now explain how a circle may be divided into any number of parts, so as to enable the mechanic to make fresh points on the dividing plate, or divide the wheel itself, with very little trouble; and as the principal difficulty is in the division of a circle into an *odd* number, the plate itself generally affording a sufficient guide for *even* parts, I shall confine my observations to this alone. It is obvious, that any *odd* number may be rendered *even*, by the simple process of subtraction; so that, if a circle is to be divided into 59 equal parts, proceed thus: $59 - 9 = 50$; and, to ascertain what proportion of the circumference of the circle will contain 9 parts out of 59, we have this plain formula:—

As 59 parts : 360° (the whole circle) : : 9 parts : x

(the corresponding arc of the circle that will contain 9 parts);

or $59 \times x = 360^\circ \times 9 = 54.9^\circ$.

If, therefore, by the aid of a sector or scale of chords, we make an angle at the centre of the circle equal to 54.9 degrees, we shall enclose a space of the circumference, equal to the *nine* parts required; now, with a pair of compasses, divide this arc or portion into *nine* equal parts, and the remainder into *fifty*, which will make up the *fifty-nine* equal parts. It is, obviously, not necessary to subtract so many parts as nine, in order to leave a convenient number for subdivision; but this advantage attends taking off a considerable number of degrees from a scale, particularly when taken from a scale of chords of a common rule, that they are, in general, less liable to be taken off inaccurately, than a few degrees. But, supposing the scale to be accurately divided, I will give another example, in which it is required to divide the circumference of a circle into 83 equal parts. Here, as before, $83 - 3 = 80$;

Then, as 83 : 360° : : 3 parts : x

Or, $83 \times x = 360^\circ \times 3$

$x = 13.01^\circ$.

Now set off, as already described, by means of a sector, 13°—the small fraction may be neglected, on the circumference of the circle; divide this arc into *three* parts, and the remainder into *eighty*, which, together, make the *eighty-three* equal parts into which the circle was to be divided.

The number of instances I have quoted in support of this mode of circular division, might be greatly extended, if requisite; but, I think, sufficient has been adduced to convince any one of its practical utility and superiority to the plate, the powers of which are restricted to the numbers marked on the concentric circles and their multiples; whereas, by a wheel, we may obtain almost any divisional number.

I remain yours, &c.,

AN AMATEUR MECHANIC.

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* That is, presuming the dividing wheel to have this number of teeth; otherwise a multiple of the number of teeth cut on the circumference of the wheel.

† A more convenient arrangement is, to have the circular head of the screw divided into any number of teeth, and a click to fix it; a subdivision on the face indicates the proportional part of one turn.

‡ The error is so small, as scarcely to be appreciable; the true value lies between 5.35 and 5.36; the latter is a trifle too high, as the former is too low, but the difference is spread over so large a surface, as to be unimportant

COMBUSTION.

(Continued from page 15.)

8. Several of the supporters and partial supporters, are capable of combining with combustibles, without undergoing decomposition, or exhibiting the phenomena of combustion. In this manner, the yellow oxide of gold and the white oxide of silver combine with ammonia, the red oxide of mercury with oxalic acid, and oxygenated muriatic acid with ammonia. Thus, also, nitrate of potash and oxygenated muriate of potash may be combined, or, at least, intimately mixed with several combustible bodies; as in gunpowder, fulminating powder, &c. In all these compounds, the oxygen of the supporter and the combustible, retain the ingredients which render them susceptible of combustion; hence the compound is still combustible. And, in consequence of the intimate combination of the component parts, the least alteration is apt to destroy the equilibrium which subsists between them; the consequence is, combustion and the formation of a new compound. Hence these compounds burn with amazing facility, not only when heated, but when triturated, or struck smartly with a hammer. They have, therefore, received the name of *detonating* or *fulminating* bodies. Thus, we have fulminating gold, fulminating silver, fulminating mercury, fulminating powder, &c.

9. Such are the properties of the combustibles, the supporters, and the products; and such the phenomena which they exhibit, when made to act upon each other.

If we compare together the supporters and the products, we shall find that they resemble each other in many respects. Both of them contain oxygen, as an essential constituent part; both are capable of converting combustibles into products; and several of both combine with combustibles and with additional doses of oxygen. But they differ from each other in their effects on combustibles. The former only produce combustion; whereas the products convert combustibles into products, without combustion. Now, as the ultimate change produced upon combustibles, by both these sets of bodies, is the same; and, as the substance which combines with the combustibles, is, in both cases, the same—namely, oxygen, we must conclude that this oxygen in the supporters contains something which the oxygen of the products wants; something which separates during the passage of the oxygen from the product to the combustible, and occasions the combustion, or emission of fire, which accompanies this passage. The oxygen of supporters, then, contains some ingredient which the oxygen of products wants. Many circumstances concur to render it probable that this ingredient is caloric.

The combustibles and the products also resemble each other. Both of them contain the same or a similar base; both frequently combine with combustibles, and, likewise, with oxygen; but they differ essentially in the phenomena which accompany their combination with oxygen. In the one case, fire is emitted; in the other, not. If we recollect that no substance but a combustible is capable of restoring combustibility to the base of a product, and that, at its doing so, it always loses its own combustibility; and if we recollect, farther, that the base of a product does not exhibit the phenomena of combustion, even when it combines with oxygen, we cannot avoid concluding, that all combustibles contain an ingredient which they lose when converted into products; and that this loss contributes to the fire which makes its appearance during the conversion. Many circumstances contribute to render it probable, that this ingredient is *light*.

If we suppose that the oxygen of supporters contains caloric as an essential ingredient, and that light is a component part of all combustibles, the phenomena of combustion above enumerated—numerous and intricate as they are—admit of an easy and obvious explanation. The component parts of the oxygen of supporters are two—namely, 1st, a base; 2nd, caloric. The component parts of combustibles are, likewise, two—namely, 1st, a base; 2nd, light. During combustion, the base of the oxygen combines with the base of the combustible, and forms the product; while, at the same time, the caloric of the oxygen combines with the light of the combustible, and the compound flies off in the form of fire. Thus, combustion is a double decomposition; the oxygen and combustible divide themselves, each into two portions, which combine in pairs—the one compound is the product, and the other the fire, which escapes.

Hence the reason, that the oxygen of products is unfit for combustion. It wants its caloric. Hence the reason that combustion does not take place when oxygen combines with products, or with the base of supporters. These bodies contain no light. The caloric of the oxygen, of course, is not separated, and no fire appears. And this oxygen, still retaining its caloric, is capable of producing com-

bustion whenever a body is presented which contains light, and whose base has an affinity for oxygen. Hence, also, the reason why a combustible alone can restore combustibility to the base of a product. In all such cases, a double decomposition takes place. The oxygen of the product combines with the base of the combustible, while the light of the combustible combines with the base of the product.

But the application of this theory to all the different phenomena described above, is so obvious, that it is needless to give any more examples. Let us rather inquire into the evidences which can be brought forward in its support.

10. As caloric and light are always emitted during combustion, it follows that they must have previously existed in the combustible, the supporter, or in both.

That the oxygen of the supporters contains either one or both of these substances, follows, incontrovertibly, from a fact already mentioned—namely, that the oxygen of products will not support combustion, while that of supporters will. Hence the oxygen of supporters must contain something which the oxygen of the products wants, and this something must be caloric, or light, or both.

That the oxygen of some of the supporters, at least, contains caloric, as an ingredient, has been proved, in a satisfactory manner, by the experiments of Crawford, Lavoisier, and La Place. Thus, the temperature of hot-blooded animals is maintained by the decomposition of air. Now if the oxygen of one supporter contains caloric, the same ingredient must exist in the oxygen of every supporter, because all of them are obviously in the same state. Hence we conclude, that the oxygen of every supporter contains caloric as an essential ingredient.

(To be continued.)

SPIRIT BLOWPIPE FOR GLASS-BLOWING.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I beg to call your attention to an article in No. 56, vol. 7, relative to an accident that happened to a correspondent, in an experiment on glass-blowing, written by me.

Should this come under the observation of "A Young Chemist," I beg to call his attention to the following:—I can easily account for the "excursion" of the cork—namely, by the smaller end of the tube being too minute for the size of the flask, or, rather, for the spirit which it contained; or, perhaps, by allowing the end of the same to come in contact with the flame. I can also account for the liquid discontinuing to boil as soon as the action commenced, if not, it should have been placed nearer the flask than the engraving represents, otherwise, the force of vapour would naturally direct the flame into a stream, as so intended.

I, as well as your correspondent, wish that his "hint may prevent a like accident," and hope, also, that he will take my "hint," that he was not altogether correct, as there is no danger, should he use common precaution; it being generally known, that the orifice must be reasonably large for any steam caused by boiling fluids.

I do not claim the simplicity of this apparatus, neither do I the blame attached to the accident. I doubt Professor Partington being in error, whom I stated to be the inventer of this well-adapted machine; but, I should say, he could not possibly be corrected by "A Young Chemist."

Had due attention been paid to the engraving in No. 33, vol. 7 (which I respectfully submit to your other readers), I am quite sure no accident would have happened. The "Young Chemist" also suggests, that if the tube had been bent, it would have prevented its occurrence. I will once more call his attention to the drawing, where he will find the tube to be nearly ninety degrees.

Thos. Fuller, Jun.

ARTIFICIAL ICE.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Understanding that a very ingenious and novel invention has appeared (the author of which I have not yet learnt), consisting in the formation of an artificial sheet of ice, which maintains its solidity even in a very high temperature, so as to afford the means of skating in the warmest summer; yet not having seen this new kind of ice, and not knowing its component parts, I am unable to form any decided opinion as to its qualities; but if it be equal in firmness and smoothness to common ice, it seems probable that much more important uses than appears to have been anticipated, might be obtained from this singular discovery. It seems that, besides affording the advantages of skating in warm weather, it might afford that of skating on land itself, by reversing the action—namely, by making the bottoms

of the skates themselves of this ice—and then they would slip on the ground with the same ease that any rough body slips upon ice. Slides for heavy draughts might also be made in the same way, of this new material, and many other objects accomplished, where the preventing of friction is required.

I remain yours respectfully,
LEWIS GOMPERTZ.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, Feb. 16, W. H. J. Traice, Esq., on the Genius and Dramatic Writings of Richard Brinsley Sheridan. Friday, February 18, J. Hemming, Esq., on Chemistry. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street. — Thursday, February 17, George Vandenhoff, Esq., Universality of Shakspeare's Genius. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City. — Monday, Feb. 14, Mr. Scales, on Printing, its Rise, Progress, and Present State. At half-past eight.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, Feb. 15, Mr. C. Clark, on the Structure of the Human Frame. At eight o'clock.

QUERIES.

I should feel obliged if "G. S., Jun.," would furnish me with a true method of drawing out a scale to construct organ square pipes, by supposing it to be different to that of the round pipes; and what kind of leather is best to use for organ bellows. L. V.

Where can I obtain the inside notes for the accordion; where in town or where in country, as I shall want a few at first, but a great number afterwards? J. W. P.

Is it possible to adulterate sulphate of copper? if so, what are the best means of detecting it? Also, what is the cheapest and best process for copying by electrotype? How to construct an electro-magnetic apparatus? D. G.

What degree of heat is necessary for the production of oxygen from the black oxide of manganese? How can oxygen be procured from nitrate of potash, and from nitric acid? H. C.

Which is the best method of polishing steel?
B. TROLE.

Does the seraphine keep in tune with the organ, and what metal is best for the tongues or springs? Can seraphine plates be purchased separate, and where? Also, if parts of the organ, as pipes, bellows, &c., can be had, and the cheapest and best place? C. R.

How to dissolve bone, so as to be able to run it in a mould? How to make and use the black japan for teaboards? Also, what is the process for decarbonizing cast steel? E. S. K.

The best method of extracting the lead from lead ashes. I have tried a great heat, but cannot get the metal to run from the ashes? How to make red lead? C. J. K.

Will "Frederick Baxter" inform me how the wheel in his diagram is set and kept in motion, or whether he expects his machine to work by means of its own power? W. F.

"T. R. Bilbrough" will oblige by explaining by what means he contrives to exclude the atmosphere entirely from the receiver of an air-pump. Also, on what authority he describes oxygen as possessed of *acidulous* properties. That Lavoisier held this opinion, I have heard, but understood the researches of more modern chemists had shown its fallacy; however, I am diffident on the subject, and request information.
A. M.

ANSWERS TO QUERIES.

"G. S., Jun.," perhaps, is not aware, that there are, at least, a dozen different modes, or, rather, applications of the same principle, for cutting screws in a lathe. The traversing mandrel is not only costly, but clumsy, and of limited utility: it is rarely used now by machinists. The best application of a guide or pattern screw affixed to the mandrel, is by Mr. Varley, described in the "Transactions of Society of Arts," vol. 43, page 90; but if "G. S." will refer to the plates illustrating Mr. Rennie's late edition of "Buchanan on Mill-Work," he will see some admirable screw-cutting engines by the first machinists of the day. I should be glad if "G. S." would oblige me with a drawing and description of his invention, which I would pledge myself not to divulge, should we disagree on terms. I am free, however, to confess, that I consider the best plan in all such cases, is, either to secure the invention by letters patent, or to give the mechanical world the benefit of the discovery; and "G. S." may depend, that if his plan be superior to any in use, he will derive more pleasure and honour by this course, than any trifling pecuniary gratuity can confer. A letter may be addressed to "A. M., care of the Editor of the PENNY MECHANIC."

"A. S." Penknife blades are, or ought to be, forged out of cast steel. In No. 63, page 27, "A. S." will find I have described the best method of hardening and tempering such articles; yet, surely, as penknife blades are to be bought for 3*s.* or 4*s.* per dozen, it is scarcely worth while to make them. A. M.

To make Blue Ink from Indigo.—Cake indigo, rubbed with water as for water colouring, with the addition of gum-water, to reduce it to the proper consistence, will, I think, answer the common purposes of ink.

"J. R. B. H. K." is informed, that he can get wheels, of every description, cut at J. Fayne and Sons', 66, White Lion Street, Pentonville;

also racks which are very superior; and, should he not have the convenience of turning them, that can be also done for him. The charge for cutting and rounding off the wheels is 6*d.* per inch in diameter, and for the racks, 2*s.* per foot.

To Paint Diagrams on Glass for a Magic Lantern.—Draw the subject on paper, and place the glass-slide over it; then, with a fine hair pencil, trace the outlines with black paint mixed with varnish, and, when dry, finish the subject in the proper colours, which must be transparent—as carmine, lake, Prussian blue, verdigris, sulphate of iron, tincture of Brazil wood, gamboge, &c.; these must be tempered with strong white varnish, to prevent their peeling off; shade with black or bistre, mixed with the same varnish.

Camera Obscura.—In No. 1, vol. 6, of the PENNY MECHANIC, "W. H. V." will find a plate and description of a portable camera obscura; in addition to which I will add, that the mirror must be inclined at an angle of 45°, and the focal length of the lens, which must be a double convex, must be equal to its distance from the back of the box.

Cause of Coal Burning better when Wet than when Dry.—The component parts of water are, eight parts of oxygen to one of hydrogen. Oxygen is the supporter of combustion; therefore coals, when wetted, increase the supply of oxygen, and, consequently, assist combustion. This fact is proved by the circumstance, that if a building be on fire, and there happen a slight fall of rain, the flames, instead of being extinguished, are subdued but for a brief period, and again burst forth with renewed fury. The same effect is observed, if the supply of water be short, and only applied at intervals. When there is a good draught, mere ashes, well wetted with water and mixed with a few cinders, burn freely. This is a fact worthy the attention of persons in an humble sphere of life, as it might become the source of great economy. HENRY WELLS.

Elasticity of Water.—Fluids are commonly divided into two kinds—non-elastic fluids and elastic fluids—that is, fluids which cannot be compressed into a smaller bulk, and those which are susceptible of compression. The non-elastic fluids are water and all other varieties of liquid bodies; but recent experiments prove, that the term is not strictly applicable to them. It has been found that water may be compressed, in a confined vessel, to a small extent, by means of a very great pressure; and it is certain that water a considerable depth in the ocean, is more dense or compressed than at the surface; water, consequently, is an elastic substance; but as it can be compressed only with very great difficulty, the term non-elastic is not altogether inappropriate. Perkins compressed water 1-12th with 2000 atmospheres. The maximum density of water is at 39° 39′, and it expands, as cooled, to 32°, the freezing point. In freezing it further expands, so that a cubic inch of water has displayed a force of 27,000 pounds. Water, saturated with a third of its weight of salt, will dissolve sugar; and, saturated with carbonic acid, dissolves iron. The difference between the Thames and distilled water, is as 1.0006 to 1. Rain water is equivalent to distilled water. The air which rises from pure water, under an air-pump, contains 34.8 per cent. of oxygen, and by boiling, 32 per cent.

P. T.

To make the Apparatus for Electrotype Engraving.—"A. B. C." will find it much cheaper to arrange his own apparatus. If he possesses a glass tumbler, or any similar vessel, he may construct an effective apparatus for the cost of one penny. The porous cell is the only thing which he will have to make. Provide a piece of wood about one inch in diameter (a large ruler, or a piece cut off a broom handle, will answer the purpose); next take a slip of brown paper, about an inch longer than the depth of the tumbler or other vessel intended to be used, and, having rolled it smoothly round the wooden cylinder three or four times, cement the edge along its whole length with sealing-wax; fold over one end, and sealing-wax that, take it carefully off the wood, and you have the porous cell. Procure a piece of zinc—any shape will answer, so long as it will go into the porous cell; affix a piece of copper wire to the zinc, and the apparatus is complete. To put it in action, three parts fill the tumbler with a saturated solution of sulphate of copper (obtainable at most chemists' in London at 6*d.* per pound), formed by pouring boiling water on the crystals, and, allowing it to stand for half-an-hour, fill the porous cell with acid or salt and water (a few drops of the former will be sufficient); place it in the tumbler, affix the medal or other object to be copied, to the end of the copper wire opposite to the zinc; bend the wire, so that the zinc may remain inside the porous cell, and the mould in the solution; suspend a few crystals, in a muslin bag, near the top of the solution, and the apparatus may be left. Renew the liquid in the porous cell every twenty-four hours, till the deposit is of a sufficient thickness. I have produced some of my most beautiful specimens by means of an apparatus which cost me 9*d.* each; consisting of a jelly-jar, holding about a pint and a half, cost 2*d.*; a porous jar of earthenware, obtained at Knight's, Foster Lane, cost 6*d.*; and a piece of zinc. It is of no importance whether the zinc is covered with acid; only some part of it must be immersed. W. F.

"A. Y. C." is informed, that the inner cell of the electrotype apparatus must be porous; either formed of brown paper, plaster of Paris, wood turned sufficiently thin, or some such material, in order that the electricity may pass through it to complete the circuit.

"A. B." is informed, that "G. S., Jun.," is only an amateur in organ-building, and does it merely for his own amusement. But, as he is acquainted with several first-rate organ-builders, he will make inquiries, and let him know the result.

TO CORRESPONDENTS.

G. S., Jun.—*We have received a description of his invention, and will take an early opportunity of giving our attention to it.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

AND CHEMIST.

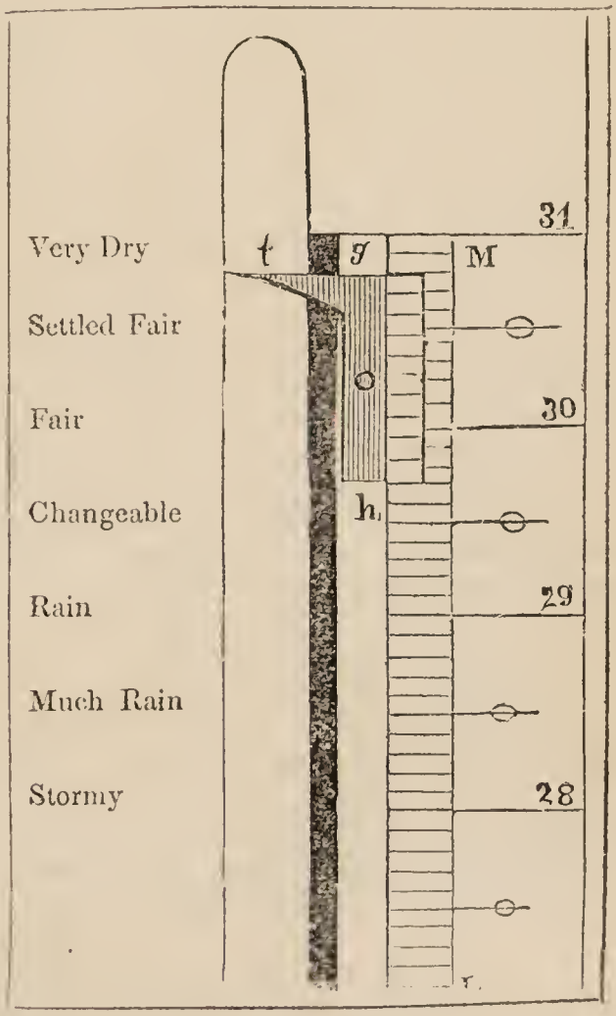
A MAGAZINE OF THE ARTS AND SCIENCES.

No. 67, THIRD SERIES. | SATURDAY, FEB. 19, 1842. | No. 315, OLD SERIES.

THE COMMON BAROMETER.

FIG. 1.

FIG. 2.



Vol. VIII.—No. 8.] [City Press, 1, Long Lane, Aldersgate Street: D A. Doudney

THE COMMON BAROMETER.

(See Engraving, front page.)

Barometers have been constructed in a variety of ways, many of which are more expensive, but none of them superior, in real utility, to the common form, represented by fig. 1. It consists of a glass tube, about thirty-four inches in length, and one-third of an inch in diameter. The upper end, A, of this tube, is hermetically sealed. By the expression "hermetically sealed," is meant the closing of a tube, &c., by the consolidation of its own substance. The glass is heated in the fire, or with the assistance of a blowpipe at a lamp, till it is partially fused; the end is then drawn out and twisted round, till the aperture is perfectly closed. The twisting is essential; a tube drawn out in a straight line, will always be a tube. It is filled with mercury well purified, and the open end, B, is inserted into a basin containing the same metal. The tube and basin are fixed to a frame of wood, and suspended in a vertical situation; and the tube, from B to E, is generally covered with wood, to prevent the breaking of it by accident; from F to A is mostly covered with plain glass, set in a frame, and opening like a door.

The mercury in the barometer tube will subside, till the column be equivalent to the weight of the external air upon the surface of the mercury in the basin, and it, therefore, becomes a measure of that weight. In this kingdom, the extremes of the fluctuations are, almost invariably, found between twenty-eight and thirty-one inches; so that the range may be considered as never exceeding three inches; and it seldom exceeds two inches and a half in any one year.

The height of the mercury in the tube, above the surface of the mercury in the basin, is called the standard altitude; and the difference between the greatest and least altitudes, is called the scale of variation.

The scale of variation attached to the upper part of a barometer, is shown more at large by fig. 2. It is furnished with an instrument called a vernier or nonius, *g h*, which is an addition of more value and greater ingenuity, than might, at first sight, be supposed. If each inch of the scale of variation, I. M, fig. 2, be divided into ten equal parts, marked with 1, 2, 3, &c., increasing upwards; and a nonius, or small scale, *g h*, whose length is eleven-tenths of an inch, be divided into ten equal parts, marked with 1, 2, 3, &c., increasing downwards, and so placed, as to slide along the line of variation, the altitude of the mercury in the tube, above the surface of that in the basin, may easily be found in inches and hundredth parts of an inch; for if the surface of the mercury in the tube does not coincide with a division in the scale of variation, place the index, *t*, of the nonius even with the surface, and, observing when a division of the nonius coincides with one in the scale, the figure in the nonius will show what hundredth parts of an inch are to be added to the tenths immediately below the index. Let, for instance, the surface of the mercury be between seven and eight-tenths above thirty inches, and the index of the nonius being placed even with it, and the figure 5, upon the nonius, being observed to coincide with a division upon the scale, the altitude of the barometer will be thirty inches and one-five-hundredth of an inch; for each division of the nonius being greater than that of the scale by one-hundredth of an inch, and there being five divisions, the whole must be five-hundredths of an inch above the number 7 in the scale; and the height of the mercury is, therefore, 30.75. The tubes of which barometers are made, should have a bore of not less than one-third of an inch in diameter, and should be perfectly clean within. To prevent their contracting any dirt before they are used, it is usual to seal, hermetically, both their ends at the glass-house. It is easily cut, by scratching it with a file, and then applying to the scratch a piece of red-hot iron.

E. L.

PNEUMATICS.

No. I.

That branch of natural philosophy, which treats of the nature, properties, and effect of the atmosphere—a body of air encompassing the earth—is called pneumatics, from the Greek word for air or breath. The air is that thin transparent fluid in which we live and move. It encompasses the whole earth to a considerable height, and, together with the clouds and vapours which float in it, is called the atmosphere. The air of our atmosphere is not (as was formerly supposed) a simple or homogeneous fluid, but, in reality, it is composed of two distinct fluids, called oxygen gas and nitrogen gas. Besides the two substances of which it is composed, it contains a portion of another gaseous fluid, called carbonic acid gas. It is also well known, that a large portion of water is generally contained in the atmosphere, besides a great variety of

substances, which are subject to evaporation, and which are capable of existing in an aëriform state at the usual temperature. The air is justly reckoned among the fluids, because it has all the properties by which a fluid is distinguished; for it yields to the least pressure; its parts are easily moved among themselves; it presses according to its perpendicular altitude, and its pressure is everywhere equal. The air differs from every other fluid in the three following particulars:—1st. It can be compressed into much less space than it naturally occupies, which no other fluid can be, except the other gases. 2ndly. It cannot be congealed or fixed, like other fluids. 3rdly. It is of a different density at different heights from the earth's surface, decreasing the higher it rises; for each stratum is compressed only by the weight of those above it; the upper strata are, therefore, less compressed, and, of course, less dense, than those below them. That the air is a real substance or body, is evident, from its excluding all other bodies from the space it occupies; for instance, invert a clean glass tumbler, perfectly dry, over a hand-basin nearly filled with water, and, when the whole of the rim is brought exactly parallel with the surface, plunge it perpendicularly downwards; it may now be observed, that the water has risen considerably in the basin: this rising is owing to the displacement, by the glass, of a volume of water equal to its own bulk, consequently, no water can be within the tumbler; for if the inverted tumbler were filled with water, of course no greater rise could be observed in the basin, than what would be caused by the solid bulk of the sides of the glass which were immersed in it. The reason, then, that no water ascends in the glass is, that, previously to its immersion, it was filled with air, which, pressing upon the water below, prevents its ascent. Another proof that no water has entered the glass is, that the inside will be found quite dry. Put a small piece of phosphorus, in a state of combustion, stuck on a cork on the surface of water in a basin, and invert over it a tumbler, as in the last experiment; the water, instead of being displaced, will rush up into the glass, and will continue to do so, as long as the phosphorus continues burning. In this case a partial vacuum is formed by the decomposition of the atmospheric air, as it supports combustion; and the consequence is, that the air external to the glass, pressing upon the water beneath with its accustomed force, causes it to ascend in the glass, there being no body present to resist the ascent. In this experiment the water, instead of ascending, will sink considerably in the basin; and, upon inspection, the inside of the glass will be found quite wet: both circumstances exactly contrary to those in the last experiment. When the glass is raised to the surface of the water in the basin, that in the glass will not quit its place; the water below forming a support to the column above it by the pressure of the atmosphere. When the glass is raised above the surface of the water in the basin, a noise is produced by the ascent of the air and the rapid descent of the water. This is caused by the comparative levity of the one and gravity of the other.

To prove the weight of the air, a pair of common bellows may serve: thus, for instance, if we stop the nozzle and secure the valve-hole closely, having first compressed all the air out of them, we shall find that a considerable force is necessary for separating the boards: they are kept together by the pressure of the air which surrounds them. Again, in like manner, if we stop the end of a syringe after its piston has been pressed down quite close to the bottom, and then endeavour to draw it up, we shall find a considerable force is requisite—viz. about fifteen pounds for every square inch of the section of the syringe. Exerting this force, we can draw up the piston and hold it there; but the moment we cease pulling, the piston rushes down again. We feel something, as it were, drawing in the piston, but it is solely the weight of the incumbent air pressing it. The air, being a fluid, presses in every direction; it presses on the syringe, as well as on the piston; for if the piston be suspended by its ring on a nail, it will require a weight to draw down the syringe, equal to that which is necessary to draw up the piston.

G. Starkey,
Mineralogical Chemist.
Church Street, Shoreditch.

DESCRIPTIVE GEOLOGY.

(Continued from page 43.)

Crabs and lobsters, of species related to the recent, have been found in the clay of Highgate, and in the Isle of Sheppey. In the cream-coloured limestone of Pappenheim, crustacea, allied to the shrimp, lobster, and cray-fish, are often met with.

In the London clay, the species of fish perfectly determined, are about fifty; but it is certain, from the fragments preserved in different collections, that this

formation encloses the remains of a much greater number. M. Agassiz states, that the London clay, particularly in the Isle of Sheppey, will be, for a long time, an inexhaustible mine.

Fossil wood occurs in vast abundance, particularly in large trunks and branches, which appear to have been drifted, and are full of perforations, enclosing shells of boring mollusca. Bognor rocks, the clay around London, Isle of Sheppey, &c., abound in specimens of this kind. The wood is dicotyledonous—i. e. like the oak, ash, &c. Leaves and stems of palms have been found in the Paris basin, and in the Isle of Sheppey, &c.; and a trunk of a tree allied to the palm, nearly four feet in diameter, at Soissons. Fruits, belonging to trees allied to the areca, pine, fir, cocoa-tree, &c., have been discovered in several localities. Accumulations of vegetable matter, in the state of lignite or brown coal, occur at Bovey Tracey, in Devon, and in various parts of France (De La Beche's "Geological Manual"). Amber, and a substance which has been called Highgate resin, are occasionally imbedded in these deposits.

Note.—In the summer of 1839, there were found, in an apparently London clay formation, near Woodbridge, remains of a quadrumanous animal.

PALÆOTHERIUM.

Most of the remains of this genus were found in the gypsum quarries of Montmartre, in the neighbourhood of Paris. The zoological position of this genus appears to be intermediate between the rhinoceros, horse, and tapir. The habits of these animals, probably, approximated to those of the tapirs. It is generally supposed, that they lived and died upon the margins of the then existing lakes and rivers. Their dead carcasses may have been drifted to the bottom in seasons of flood, and some, perhaps, retired into the water to die. The species (of which there are eleven) varied greatly in size; some having been as large as a rhinoceros, and others having ranged from the size of a horse to that of a hog.

According to Dr. Mantell, in his "Wonders of Geology," "the palæotherium magnum was fully as large as a horse, but more thick and clumsy; it had a massive head and short extremities. It was like a large tapir, but with differences in the teeth, and a toe less on the fore feet. From the conformation of the nasal bones, no doubt can exist of its having been furnished with a short proboscis or trunk" (p. 225).

ANOPLOTHERIUM.

Five species of anoplotherium have been discovered in the gypsum of Paris. The most remarkable are, *a. commune*, and *a. gracile*. The first was of the height of a wild boar; low on the limbs, probably like the tapir, but its long and powerful tail, equalling the body itself in length, made it still more an essentially aquatic animal. The great size of its members, the depressed and heavy proportions of its body, and its long tail, compressed horizontally at the base, must have given it much of the external form of the otter; but it resorted to lakes and marshes, not for the purpose of preying upon other animals, but in search of aquatic plants; while the depressed form of the tail shows that it must have swam with greater facility than either the tapir or hippopotamus.

Anoplotherium Gracile.—This animal, to which Cuvier gave the name of gracile, from its elegant proportions, was of the size and form of a gazelle, and, consequently, a complete contrast to the *a. commune*. It must have lived after the manner of the deer and antelopes, upon dry aromatic herbs, and was provided with long moveable ears, to warn it of the approach of danger.

LOPHIODON.

No less than fifteen species of lophiodon have been recorded. In the "Regne Animal," Cuvier places lophiodon between palæotherium and the tapirs.

ANTHRACOTHERIUM.

This name was given to an extinct quadruped, belonging to the pachydermata; because it was found in lignite, or coal of the tertiary strata. Etym.—*anthras*, coal, and *ther*, wild beast.

CHÆROPOTAMUS.

This genus was instituted by Baron Cuvier, on the examination of the jaws, whose general form and dimensions are analogous to those of the hog, and which would seem to belong to an animal nearly approaching the peccaries or indigenous hogs of South America, but larger.

ADAPIS.

This creature belonged to that tribe of animals which M. Cuvier denominates pachydermata, and which includes all hoofed animals that do not ruminate or chew the cud. As only three fragments of skulls have, as yet, been found, not much is known respecting it.

REVIEW.

Craig's Patent Rotary Steam-engine explained and illustrated; with a Concise Review of the Invention of the Piston-engine. London: Houlston and Stoneman; 8vo., pp. 36.

From the commencement of this Journal, it has been our aim to lay before our readers an impartial account of all inventions and improvements of real practical utility. The seven volumes before the public prove, that our pages have never been made subservient to personal views. One object we have steadily pursued—the advancement of knowledge among the working classes—and this, we apprehend, has gained for us the confidence of men of all grades and opinions; since our columns have been, and ever shall be, open to the journeyman as well as the master.

The wonderful, and almost magical, changes brought about by the application of steam as a motive power, naturally lead us to regard, with unwonted interest, any mechanical arrangement which may tend to place the gigantic powers of this extraordinary agent within the reach of men of moderate capital; especially as the *first cost* of a steam-engine, of the usual construction, and the enormous consumption of fuel required for the conversion of water into vapour, are so considerable, as to make it doubtful whether steam can be *profitably* employed in lieu of animal power, except in manufacturing operations on a large scale. These objections, however, are reduced, if not entirely obliterated, by the rotary engine, which, being much more simple, as it has no cylinder, beam, crank, fly-wheel, parallel-motion apparatus, condenser, air-pump, or other intricate mechanism, is much less expensive, and less liable to derangement or accident. Our readers are, doubtless, aware, that the piston-engine is a very complicated affair; but its parts are so "beautifully arranged and exquisitely adjusted, as to produce mechanical effects by the agency of steam." Yet it must be borne in mind, that "the *vis inertiæ* of these heavy masses of metal having to be overcome, and the friction of the various parts being very considerable, a great portion of the mechanical force of the steam is required to *keep the machine itself in motion*, before any "useful effect" is produced. From the quantity of uncondensed steam, the friction of the parts, and other sources of resistance in the steam-engine, it is generally reduced about one-half, in its effective operation, as a moving power. Beautiful, therefore, as the piston-engine is, and wonderful as are its operations; yet it must be considered as an imperfect machine, so far as its power and efficiency, in relation to steam, are taken into account. Its action being *reciprocating*, involving the necessity of many mechanical arrangements to produce, ultimately, a rotary motion, is one great cause of its loss of power, "if not in a theoretical point of view, yet certainly in practice" (p. 14).

That all these objections had occurred to the mighty mind of Watt, we must suppose—inasmuch, that a rotary engine was the problem which he studied to solve, but in vain; as the specifications of his patents—for we think he applied more than once for letters patent on this subject—plainly show.

It will not be expected that we should follow the author of this *brochure* through all his statements. The main advantage of the rotary, compared with the piston-engine, may be stated in a very few words—simplicity of construction, economy, both as regards fuel and the foundations, buildings, &c., direct application and easy transmission of power, immediately from the axis of the machine, without the intervention of cranks, beams, or other auxiliary apparatus—then may be summed up, as reduced expense in producing, and great facility in applying, steam power, two items of great consequence, and deserving the most serious consideration.

With respect to the details of construction in this engine, said to have been patented by Mr. Craig in 1834, they are well and clearly explained in the letter-press, and illustrated with three very beautiful views (one sectional) of the engine itself, engraved on zinc; but we have a notion that, previously to 1834, we read, in one of the scientific journals of the day, an account of an American rotary engine, invented by a Mr. Avery, which certainly bears a strong family likeness, even in its minor arrangements, to that now ostentatiously introduced to public notice, as an emanation of Mr. Craig's genius, brought forth "after years of anxious labour, and a vast expenditure of money." If the invention belong to the American, in the name of honesty let him enjoy the fruits of his industry and talent; but if, on the contrary, Mr. Craig can substantiate his title to priority—that is, presuming the two engines identical, of which we have no doubt—no one will be more ready to congratulate him than ourselves; but, until this be done, we shall be compelled, however reluctantly, to regard our coun-

tryman as one who would acquire fame at the expense, and to the manifest injury and prejudice, of another.

MECHANICAL ORIGIN OF THE FOLEY FAMILY.

The most extraordinary and best attested instance of enthusiasm, existing in conjunction with perseverance, is related of the founder of the Foley family. This man, who was a fiddler, living near Stourbridge, was often witness of the immense labour and loss of time caused by dividing the rods of iron necessary in the process of making nails. The discovery of the process called splitting, in works called splitting mills, was first made in Sweden; and the consequences of this advance in art, were most disastrous to the manufacturers of iron about Stourbridge. Foley, the fiddler, was shortly missed from his accustomed rounds, and was not again seen for many years. He had mentally resolved to ascertain by what means the process of splitting bars of iron was accomplished; and, without communicating his intention to a single human being, he proceeded to Hull, and thence, without funds, worked his passage to the Swedish iron port. Arrived in Sweden, he begged and fiddled his way to the iron-foundries, where, after a long time, he became a universal favourite with the workmen; and, from the apparent entire absence of intelligence, or anything like ultimate object, he was received into the works, to every part of which he had access. He took the advantage thus offered, and, having stored his memory with observations and all the combinations, he disappeared from among his kind friends as he had appeared—no one knew whence or whither. On his return to England, he communicated his voyage and its results to Mr. Knight and another person in the neighbourhood, with whom he was associated, and by whom the necessary buildings were erected, and machinery provided. When, at length, everything was prepared, it was found that the machinery would not act; at all events, it did not answer the sole end of its erection; it would not split the bar of iron. Foley disappeared again, and it was concluded that shame and mortification at its failure had driven him away for ever. Not so: again, though somewhat more speedily, he found his way to the Swedish iron-works, where he was received most joyfully; and, to make sure of their fiddler, he was lodged in the splitting mill itself. Here was the very aim and end of his life attained, beyond his utmost hope. He examined the works, and very soon discovered the cause of its failure. He now made drawings, or rude tracings; and, having abided an ample time to verify his observations, and to impress them clearly and vividly on his mind, he made his way to the port, and once more returned to England. This time he was completely successful, and, by the results of his experience, enriched himself, and greatly benefited his countrymen.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Friday, Feb. 25, Election of Officers. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, February 24, George Vandenhoff, Esq., Universality of Shakspeare's Genius. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Feb. 21, Mr. W. Farren, on the Necessity of a Trades' Hall, as a practical effort to promote the Moral and Social Improvement of the Working Classes of the Metropolis. At half-past eight.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, Feb. 22, Mr. Moore, on Electricity, with Experiments. At eight o'clock.

QUERIES.

How to test the purity of carbonate of soda and tartaric acid? M. R. C. S.

Can you inform me if any person has got a turning lathe for sale, similar to that described in No. 37, Third Series? Address to "J. W. G., care of Mr. Peterken, printer, 79, High Street, Poplar."

I have some electrical and galvanic apparatus, which I wish to exchange for a small working model of a steam-engine. Perhaps some one would be willing to make such an exchange. Their address through the medium of the PENNY MECHANIC, will oblige W. W. W.

What is the best and safest preparation for dyeing the face, &c., a copper colour? N. M.

The best method of red dyeing on calico, commonly called Turkey red, as now generally practised in the dyeing districts in Lancashire; or the component parts used in that dye. J. H. L.

How are the skins of rabbits, &c., prepared, so as to resemble chamois? J. V. G.

I require a cord of India rubber, similar in size and texture to a watch-guard, and about thirty feet long; where can I obtain it?

W. H.

ANSWERS TO QUERIES.

A Cubic Foot of Water weighs 62½ lbs., therefore a cubic inch will weigh 11 dwts., 13$\frac{7}{9}$ grs.

"R. W. Beekley" will find "a four-way cock" the simplest method of letting steam above and below the piston, in a model of a locomotive steam-engine. I think its construction and action are too simple to need any explanation; but he will find a description of it at page 124 of Dr. Lardner's "Treatise on the Steam-engine."

W. H.

To keep Locks and Keys free from Rust, anoint them with the following composition:—Take one pound of hog's lard free from salt, one ounce of camphor, two drachms of blacklead powder, two drachms of dragon's blood in fine powder. Melt the same on a slow fire until it is dissolved, and let it cool for use.

"A Working Man." Oxygen gas increases the brilliancy of the flame, and carbonic acid gas extinguishes it.

"J. S." There is no remedy for your poor looking-glass, but resilvering. As for the glass ornaments, with a steel drill and bow, and keeping the place moistened with spirits of turpentine, you may bore away as quickly as you like.

To Stain Bone or Wood.—Take strong white-wine vinegar in a glass vessel, and put to it filings of copper, with some Roman vitriol, roach alum, and verdigris, and leave it thus infused for seven days; then boil it in some vessel, and, by putting into it bone, ivory, or wood, it will penetrate, and give it a green colour. If any other colour is required—as red, blue, or yellow—put Brazil wood, indigo, French berries, or any other such colours, to infuse in the vinegar, with a little roach alum. For black, drop a little oil of vitriol into a small quantity of water, rub the same on your wood, then hold it to the fire, until it becomes a fine black; and, when polished, it will be exceedingly beautiful. J. V. G.

Electrical Machine.—"A. Y. C." may make an electrical machine from a bottle; but he would learn more from inspecting one already made, than from directions. If the bottle has a long neck, it should be cut off within an inch and a half or two inches of the shoulder, and a flat, or convex, or conical piece of wood (according to the shape of the bottom), with an elongation corresponding to the neck at the opposite end. A cap should be cemented on the neck, the said cap having a hole bored on one side of its axis, for the expansion of the air contained in the bottle; and the bottle may then be centered on pillars, in a way that will occur to "A. Y. C.," and which needs no farther explanation.

Leyden Jars may be covered with the foil by means of paste. If the mouth is narrow, they may be filled with iron filings, and a wire thrust into them.

To Detect Nitric Acid in a Solution supposed to contain it.—Nitric acid bleaches sulphate of indigo; therefore, by adding a suspected solution to the diluted sulphate, prepared by dissolving a small piece of indigo in concentrated sulphuric acid, and tinging water blue with the solution, we ascertain the presence or absence of nitric acid in the solution.

In making Electrotypes, it is essentially necessary that the inner vessel should communicate with the outer, or, rather, the material of which the inner is made, must be porous in some part of it. A wide-mouthed bottle, with the bottom cut off, and a little fluid plaster of Paris run into the bottom and allowed to harden, will answer every purpose; the object being to allow the electricity to pass through the vessel, and yet keep the two fluids separate.

To make Muriate of Manganese.—Dissolve black oxide of manganese in muriatic acid, avoiding the chlorine gas which is given off from the decomposition of the acid.

The Use of Arsenic in Stearine Candles is to prevent their crystallization; stearine being one among many other bodies which have a disposition to assume a geometrical and determinate form when allowed to cool slowly after melting. This crystallization may be prevented, by immersing moulds containing the candles, when in a fluid state, into cold water.

Electrical Jars made of Cedar, will do to separate the fluids in electrotype, provided the jar be soaked in a solution of alum, to remove the resin in which all the pine tribe abound. Sycamore wood will answer the same purpose.

Sulphate of Copper may be purchased at 6*d.* per pound.

"Y." The amalgam referred to, is nothing more than mercury, which is applied to the surface of the zinc plate, previously allowed to lay a minute or two in diluted nitric or sulphuric acid, the mercury being then rubbed over the plate with the fingers. W. Thompson.

"Mr. Starkey." The "Anatomists' Vade Mecum" is published by Churchill, Prince's Street, Soho. Mr. Bumpus, 5, Holborn Bars, will get the book for him, and allow a more liberal discount than the publisher.

To Remove Hair from the Skin.—If "S. S." wishes to use what is called a depilatory, I would advise him to do so with great caution; as no knowledge of chemistry is requisite to teach that a caustic substance, which will destroy hair, will destroy, also, the skin, if it be allowed to remain long enough in contact with it. The following he will find as mild and effectual as any with which I am acquainted:—Powder of quicklime, one drachm; carbonate of soda and starch powder, of each two drachms. Mix. Apply in the form of a paste. To be washed off when dry.

"B. A." asks, "Do posture-masters rub their joints with oil?" Whether they do or not, I cannot say; but I know, that if they do, it cannot be of any use; as oil, applied to the skin, cannot possibly affect the internal structure of joints. The flexibility of limb acquired by opera dancers, clowns, harlequins, and other gentry of that kind, is the result of long-continued practice, unremittingly pursued, until premature old age obliges them to discontinue the practice of their profession.

"W. R. L." The small pipes in bird-organs are made of an alloy of lead three parts, tin one

part. For tuning pipes of all kinds, see my paper in No. 62 of PENNY MECHANIC, on that subject. If he wishes to make an organ, he would find small wooden pipes the easiest to make and tune; and, should he let me know, I will give him a scale and instructions. I can sell him, if he likes, a small organ I have, with three stops (metal), of which the barrel is not pricked or pinned, for 10*s*.

"J. S." The only metal that will not be oxidized by steam in contact with it when in a state of ignition, is platinum.

"E. F. B." Surfaces which readily absorb heat, also radiate it most readily. Those which reflect heat most—such as polished surfaces—radiate least; consequently, the Arnott stove will give out most heat, if left black.

"J. R. B. H. K." would only waste both his time and money in trying to make the reeds for pipes. It is a most difficult part; nevertheless, I will endeavour to get him the scale. He had better make patterns of his wheels in wood, and get them cast in brass at any brass-founders. There are two brass-founders in Belton Street, St. Giles. It is also the cheapest way to get them.

G. S., Jun.

In answer to your correspondent "A. M.," I have to mention, that my note was in answer to one having his signature, and inserted in No. 57. If, therefore, he will refer to that, and see the two in connexion, he will, perhaps, see the point of my communication. Your correspondent does me great injustice, if he supposes that I would speak or think in the slightest degree contemptuously of amateurs. Nothing could be so much at variance with my sentiments. In fact, I was not aware that "A. M." was such. The impression produced on my mind was, that some individual, in the note which I answered, was speaking from his own circumscribed knowledge or practice. Being myself an enthusiastic admirer and follower of science generally, and of mechanics in particular, I cannot but feel respect and admiration for those who, actuated by an impulse which may be more easily felt by the subject of it than described, devote what time and energy they can spare to its pursuits. I cannot but know, that it is from the minds of lovers of science—in other words, from men of genius—that all the grand and wondrous fabrics, reared by the art of man, have sprung. The common herd of mankind, the mere machines, may despise, because they cannot comprehend, such master minds; but an intelligence is happy in itself, and finds, in its favourite pursuits, a reward which amply repays its utmost efforts. But to return. I now conjecture, that the signatures "A. M." and "An Amateur Mechanic," belong to one and the same correspondent. Will you allow me to suggest to him, and the rest of your correspondents, the convenience of using always the same signature? With regard to slide-rest tools, they being generally used for the purpose of cutting substances softer than tempered steel, of course they should be tempered: but if I required to turn a piece of blued steel, perfectly true, in the lathe, I should use the slide-rest, with a tool hardened by being heated to a red heat, and immediately dropped into oil. I would observe (that which is, doubtless, known to "A. M."), that much depends on the angle to which the tool is ground—a matter which is best determined by trial. I perceive that your correspondent has been misled by a slight error of the press, in my note to him in No. 61, the word "stove" being substituted for the word *stone*. I hope that this communication will remove from the mind of "An Amateur Mechanic," or any other of your readers, the impression that I think lightly of natural talent under any circumstances.

If "J. Fitzpatrick will state for what purpose he requires the battery, or whether he wishes to construct it on any particular principle, I will endeavour to assist him through the medium of your journal.

"M. O. X." A wooden cell will answer; the thinner it is made the better. Sulphate of copper may be obtained at 3*s*. per 7 lbs., at Newberry's, Fetter Lane; Griffith's, Clerkenwell Green; and Sapsworth's, High Street, Islington. Directions for using the bronze, are usually pasted on the bottles. The price of an apparatus would depend on the description. If with a porous cell, I should recommend, first, a square mahogany box, about four inches deep, coated inside with electrical cement; cost, at the utmost, 3*s*.; two porous cells, 6*d*. each; two binding screws, 6*d*. each, and two zincs, 1*d*. each: total, 5*s*. 2*d*.

"Y." The zinc is first cleaned with dilute nitric acid, and then rubbed with a cork or flannel, dipped in mercury, till it becomes bright.

W. H.

TO CORRESPONDENTS.

W. Block.—*The article recommended for intoxicating birds, was a small quantity of nux vomica strewed on the bait.*

Tyro *will find the method of preparing photogenic paper in No. 9 of the last volume, page* 72.

J. V. G.—*We thank him for his hints, but cannot give him credit for much investigation, when he speaks of the number of queries that remain unanswered. If he will take the trouble to look over a few Numbers, he will find that there are very few which are not replied to, either by our correspondents or ourselves.*

X. X. X.—*We really cannot inform him positively on the point; such a thing being scarcely ever, perhaps, thought of; but we think it would be a very dangerous business to undertake. An excise officer would, no doubt, be able to inform him more fully on the subject.*

ERRATA.—In No. 64. in the recipe for making permanent ink, for "one grain of argenti nitras," read *one drachm*.

In page 54, for "ninety degrees," read *one hundred and eighty*.

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

Nos. 68 & 69, THIRD SERIES. | SATURDAY, FEB. 26. PRICE TWOPENCE. | Nos. 316 & 317. OLD SERIES.

BILBROUGH'S PERCUSSION WATCH ESCAPEMENT BANKINGS.

Fig. 1.

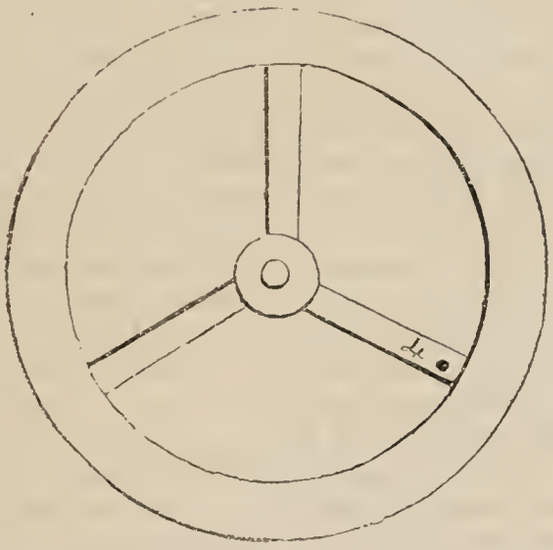
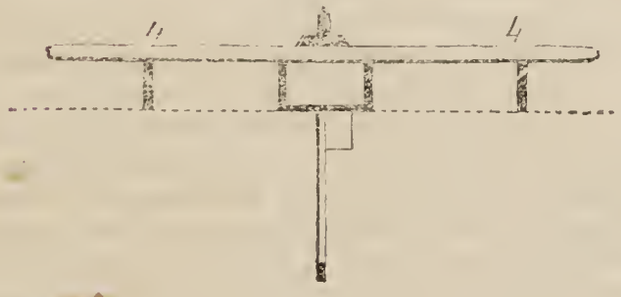
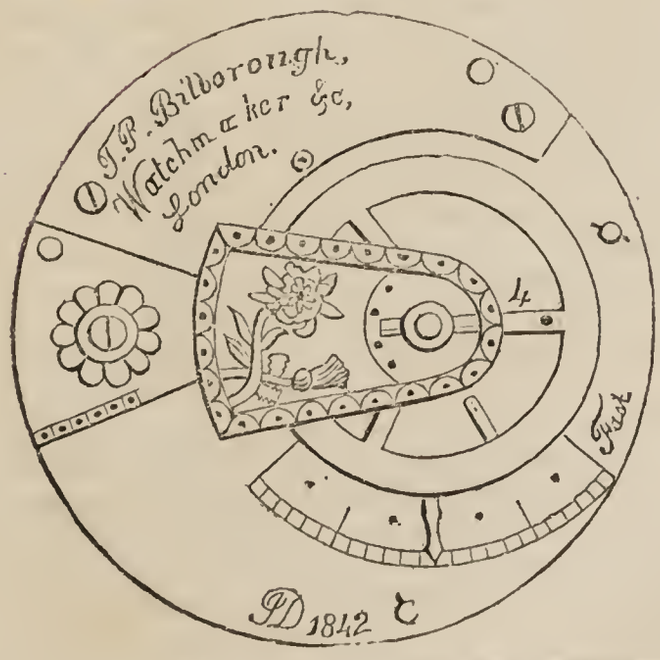


Fig. 2.





Vol. VIII.—Nos. 9 & 10 | City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

BILBROUGH'S PERCUSSION BANKING.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—I herewith send you a description of a percussion banking I have constructed, which, if you think worthy of notice in your useful Magazine, you will oblige me by inserting it.

The percussion bankings are applicable to escapements of every description, where the balance does not make above one revolution—the vertical and horizontal escapements, for instance. To the watch-manufacturer and wearer, the above bankings will be of considerable importance, as regards the safety of the verge and balance-wheel; while the bankings in general use—viz. the cock-plate and pottance bankings are, in general, the cause of their breaking, which I will endeavour to explain:—1st. In the plate and pottance bankings, it is to be observed, that the pallets of the verge striking against the pins in the plate and pottance—the resistance being so near the axis and fulcrum—there is the whole shock or jar of the balance on the pivots or body of the verge, which either snaps the body or cock pivot off; then the verge being at liberty or out of the perpendicular, the watch runs down, and injures the teeth of the balance-wheel, either in bending or breaking them, by coming in contact with the verge-pallets. 2ndly. In the plate and cock bankings, where the banking-pin is placed in the edge or rim of the balance, which, striking against the cock or pins in the plate, the vibration is suddenly checked, and, not striking solid, it occasions a jarring or shaking through the whole of the balance and body of the verge, when the result is the same as the above-mentioned pottance bankings.

To the bankings I have constructed, the pin is to be placed in the bar of the balance, one-third distant from the outside edge of the rim (which is the point or centre of percussion), to strike against two pins in the plate, placed under and free of the balance, which will give solidity to the balance and verge, thereby insuring their safety.

I have constructed the above-mentioned percussion banking, to supersede the bankings that are in use, since they are open to so many objections; and, I trust, that, as they are founded on scientific principles, they will meet with general adoption.

Any gentleman wishing to test the efficacy of percussion, has only to procure a rod of metal, or piece of wood of any length, which I will call lever, and, taking hold of one end of it, and striking the other end upon anything, he will observe it rebound from the object struck against; but if he strikes about one third from the outer end, it will not rebound, but the stroke will be solid. The experiment is the same with the balance, it being a combined series of levers, where the axis is the fulcrum of them.

Description of the Engraving.

Fig. 1, horizontal view of balance, showing the situation of the banking-pin.

Fig. 2, perpendicular view of ditto, showing the pins in the plate for banking-pin to strike against; the dotted line represents the edge of the upper plate.

Fig. 3, horizontal view of upper plate, with bankings applied.

Fig. 4, banking-pin.

I remain yours, &c.

T. R. Bilbrough.

IMPROVED COLLAR FOR LATHE MANDREL.

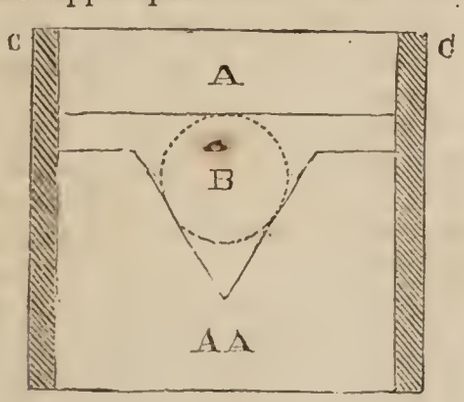
To the Editor of the Penny Mechanic and Chemist.

Sir,—I cannot better meet the wishes of your correspondent, "W. H.," than by describing, if you will allow me, the course I adopted in constructing a very superior lathe; especially as the machine combines, I believe, all the latest improvements, and presents some novelties; so that, if not a perfect, it may fairly be considered an almost universal, machine, in its application. The first step I took was, to ascertain the best—that is, the least complicated and most effective description of lathe, including the bed or bar, puppets, mandrel, collars, and slide-rest. To obtain this information, I carefully studied all that has been published on the subject, and procured drawings of lathes of recent and improved construction. Thus armed, I set to work, and tested the presumed superiority of every part of any consequence, by actual experiment. This tedious process necessarily occupied much time; but it has amply rewarded me, by a vast mass of practical details, which, otherwise, I could not have acquired; and the result is best shown, by the machine itself being susceptible of every mechanical arrangement compatible with a rotary movement—that is to say, by it screws of any pitch

may be cut, and every variety of plain, circular, or eccentric work, performed; it also answers for boring or drilling, sawing, and otherwise shaping metals; likewise for cutting teeth in wheels.

Preliminary, however, to this description, I must observe, in reply to "W. H.'s" letter, that I cannot accede to his doctrine respecting the *cause* of *friction*. The circumstances to which he alludes may, and, possibly, do aggravate, but never can generate, friction; the true cause of which is, probably, a disturbance of the electrical equilibrium; as we find the *heat* evolved by the attrition of any two substances, becomes a principal agent in the production, as well of the electrical phenomena, as of friction. Moreover, it is stated by Professor Vince and MM. Coalomb and Morin, who have devoted much attention to the subject, that *similar* materials have more, and *dissimilar* less, friction; that the interposition of any oleaginous matter tends to reduce friction; facts which bear a close resemblance to the known laws of electrical attraction and repulsion. I offer this opinion with extreme diffidence, but in the hope that some of your scientific readers may be induced to make a series of experiments on this most interesting, but, hitherto, vexatious problem to mechanics.

Some few years ago, a French amateur of some celebrity, introduced a new form of collar, which, from its shape, he called the V collar. In all cases where a conical collar cannot be employed, I consider this V very superior to the old-fashioned circular double collar, although it partakes of some of its disadvantages, but in a much less degree; as will be manifest, from a slight inspection of the subjoined figure. A is the upper portion of the collar; A A,



the lower; the shaded parts, C C, show the chamfered sides, to slide in grooves in the puppet. The dotted circle, B, represents the position of mandrel. Its chief advantage depends on the mechanical axiom—that the more we reduce points of contact between the parts in motion, the nearer we approach perfection in the construction of machinery; and for this simple reason—the force of inertia to be overcome, is much less. Now if we apply this rule to the V collar, compared with the circular, its superiority becomes very apparent—inasmuch, that the friction of a mandrel working in the former, will be, to the friction of the latter, under similar circumstances, as *three* to *one hundred*; moreover, it retains the mandrel more equally and securely in its place, as the three points of contact assume the figure of an equilateral triangle. Now, in a circular collar, the points of contact are always variable, even supposing, at first, by a rare precision of workmanship, the interior surface of the collar equally touches the whole of the circumference of the collets. This accuracy is soon destroyed by friction, or, in other words, "wear and tear" of the materials; and then a tremulous vibration becomes apparent, which can never happen to a mandrel revolving on three points.

In some departments of ornamental turning, it would be, I fear, impossible to adopt a conical collar: I allude to work which requires a traversing movement of the mandrel; but, as this necessity seldom occurs in practice, I apprehend few would hesitate, on that account, to discard the double circular collar, with all its manifest imperfections.

I am indebted to "W. H." for pointing out an inaccuracy I committed, in speaking of Mr. Hick's lathe. I was confident—as, I am sure, every one must be, who enjoys the pleasure of Mr. Hick's acquaintance—of that gentleman's rigid accuracy. On referring to the letter, I find the time stated to be *six* or *seven* years; how the mistake originated, I cannot tell; except that it was *unintentional*; but I am quite certain a mandrel, working in a conical collar of cast steel hardened, will last many years longer than I alleged. I have used a small triangular bar foot-lathe within the last few weeks, which I have known upwards of *twelve* years, and, I understand, it is nearly *thirty* since it was purchased by the uncle of the present proprietor, a gun-maker in the neighbourhood. It has a conical collet and collar, both of steel—the former soft, and the latter quite hard; the working parts are, in every respect, as good and perfect as when it left the maker's hands; nor do they exhibit the slightest trace of wear. I beg, however, to be distinctly understood by "W. H.," I do not claim for clumsy or inaccurate work this durability; the parts in contact must be fitted and adjusted with the nicest care, otherwise a

very different result will be apparent at the end of a few months.

I observe, in Mr. Gill's "Machinery Improved," a singular confirmation of this observation; alluding to the epicycloidal curve, as applied to the teeth of wheels, he says, "Two large pinions, of thirty inches in diameter, and two, of twenty inches, were cast so large, as to be what is termed *chipped and dressed most accurately to form*; and, notwithstanding that the grease with which they are lubricated, is continually mixed with the particles of grindstone-dust flying in the air, and arising from the racing or turning the peripheries of the stones into shape, from time to time; and, consequently, they are placed under the most favourable circumstances for wearing by friction, had there been any; yet, during the several years that I saw them in daily use, the marks left by the chisel and file in shaping them, were never obliterated. These large pinions have teeth, which have not only acted for nearly *fifty years*, but, as I am informed, are likely to continue in a good working state for *twenty years* to come!" Now Mr. Gill's statement corroborates what I have advanced. Had any other than teeth of an epicycloidal shape been introduced, or even then imperfectly formed, I much question whether they would have endured the wear of a grinding and gun boring mill *one-tenth* of the time specified. I am quite satisfied, double or reversed cones, made of cast steel, and carefully hardened, fitted to a lathe mandrel, in the way I suggested in my former paper (Nos. 58 and 59, page 459), will amply justify all I have advanced respecting them, both by truth of movement, and almost total absence of perceptible wear.

I avail myself of this opportunity to refer "W. H." to Mr. Gill's work already quoted, page 40; also to his "Technicological Repository," London, 1829; vol. 3, page 313, where he will see some valuable communications on this subject, by that celebrated engineer, Mr. Jacob Perkins.

I confess I cannot see any inconvenience arising from a longitudinal change in the position of a mandrel, especially as it would be very trifling in amount. The axis carrying the *slow-movement* gearing is easily arranged; nevertheless, I shall be obliged if "W. H." will favour me with a sketch of his proposed improvement.

I remain yours respectfully,

AN AMATEUR MECHANIC.

Aberedwy, South Wales.

DESCRIPTIVE GEOLOGY.

(*Continued from p. 60.*)

MIOCENE PERIOD.

A SERIES of deposits, possessing characters which point out an epoch of formation distinct from, and, probably, long subsequent to, that of the strata lying immediately above the chalk, is largely developed in various parts of Europe. These strata may be classed as in the annexed table:—

Miocene	Marine	Strata of Touraine, Bordeaux, Valley of the Bormida, and the Superza, near Turin, and Basin of Vienna.
	Volcanic	Hungarian and Transylvanian volcanic rocks. Part of the volcanoes of Auvergne, Cantal, and Velay.
	Fresh water	Alternating with marine strata at Saucats, twelve miles south of Bordeaux.

Organic Remains.—From an attentive study of the organic remains, it appears that the miocene system of deposits contains an admixture of the extinct genera of mammalia of the eocene period, with the earliest forms of genera which exist at the present time. Here the remains of palæotherium, anthracotherium, and lophiodon, which formed the prevailing genera in the eocene series, are found mixed with bones of the dinotherium, tapir, mastodon, rhinoceros, hippopotamus, hippotherium (allied to the horse), ox, machairodus (allied to the bear), gulo or glutton, pangolin, agnotherium (allied to the dog, but as large as a lion), deer, &c.

The remains of corals and fishes are not unfrequent. The shells are usually in a high state of preservation, even to their colours, and the ligament which unites the valves. They are referrible to species and families, of which the habits are ex-

tremely diversified; some living in deep, others in shallow, water; some in rivers, others at their mouth.

I now purpose to place before the reader a short description of some of the most remarkable animals that lived upon the earth or in the water, during the time of the deposition of the miocene strata.

DINOTHERIUM.

Two species only have been discovered. The largest is called *dinotherium giganteum*, and is calculated to have attained the length of eighteen feet.* The bones of the head and teeth are the principal remains hitherto found. A scapula (or shoulder-blade) is the principal bone of the body yet discovered. In the autumn of 1836, an entire head was disinterred, measuring about four feet in length and three in breadth.†

It appears probable that the dinotherium, like the family of the tapirs, to which it was most nearly allied, was an inhabitant of fresh-water lakes and rivers. Its lower jaw, which was nearly four feet long, was loaded with heavy tusks at its extremity, which were employed as instruments for raking and grubbing up by the roots large aquatic vegetables from the bottom. They may also have been applied, with mechanical advantage, to hook on the head of the animal to the bank, with the nostrils sustained above the water, so as to breathe securely during sleep, while the body remained floating, at perfect ease, beneath the surface. The animal might thus repose, moored to the margin of a lake or river, without the slightest muscular exertion, the weight of the head and body tending to fix and keep the tusks fast anchored in the substance of the bank—as the weight of a sleeping bird keeps the claws clasped firmly around its perch. These tusks might have been farther used, like those in the upper jaw of the walrus, to assist in dragging the body out of the water, and also as formidable instruments of defence. The structure of the scapula‡ seems to show, that the fore leg was adapted to co-operate with the tusks and teeth, in digging and separating large vegetables from the bottom. The account of this animal in Dr. Buckland's "Bridgewater Treatise," concludes thus:—"From the near approximation of this animal to the living tapir, we may infer that it was furnished with a proboscis, by means of which it conveyed to its mouth the vegetables it raked from the bottom of lakes and rivers by its tusks and claws."

I think it right to state, that the opinion of several of the French zoologists (MM. de Blainville, Duméril, and St. Hilaire) is at variance with the above account, collected from the works of Drs. Kaup and Klipstein, and Prof. Buckland.

MASTODON.

From a careful attention to every circumstance, M. Cuvier supposed, that this animal did not surpass the elephant in height, but was a little longer in proportion, its limbs rather thicker, and its belly less. It seems to have much resembled the elephant in its tusks (which average from ten to fifteen feet in length), and, indeed, in the whole of its osteology; and it also appears to have had a trunk, but the form and structure of the grinders are sufficiently different from those of the elephant, to require its being placed in a distinct genus. Its food is supposed to have been similar to that of the hippopotamus and the boar. It does not, however, appear to have been at all formed for swimming, or for living much in the water, like the hippopotamus, but rather to have been entirely a terrestrial animal.

PANGOLIN.

M. Schleyermacher called the attention of Cuvier to a bone, of which he sent the great French zoologist a plaster cast. This bone was the ungueal phalanx of an edentate mammiferous quadruped, and Cuvier came to the conclusion—which has not been disputed, but, on the contrary, entertained by many well qualified to judge—that it belonged, probably, to a pangolin of gigantic stature. Taking this ungueal bone for his basis, Cuvier measured the animal to which it must have belonged, as having extended to the length of twenty-four feet. This great length will not much surprise those who recollect the enormous proportions which characterise some of the extinct saurians.

The upper Val d'Arno is one of the most noted places for its collection of fossil bones. The deposits in which they occur, are lacustrine—i. e. the materials must have been deposited in fresh-water lakes. These bones belong to quadrupeds of warm climates; some of them inhabitants of swamps, and all of extinct species. They are the mastodon, elephant, rhinoceros, and hippopotamus. The skeletons of the latter are exceedingly abundant,

* The dinotherium is the largest of all terrestrial mammalia yet found, exceeding even the largest fossil elephant.

† Casts of these may be seen in the British Museum.

‡ This, in form, resembles more nearly that of a mole than any other animal.

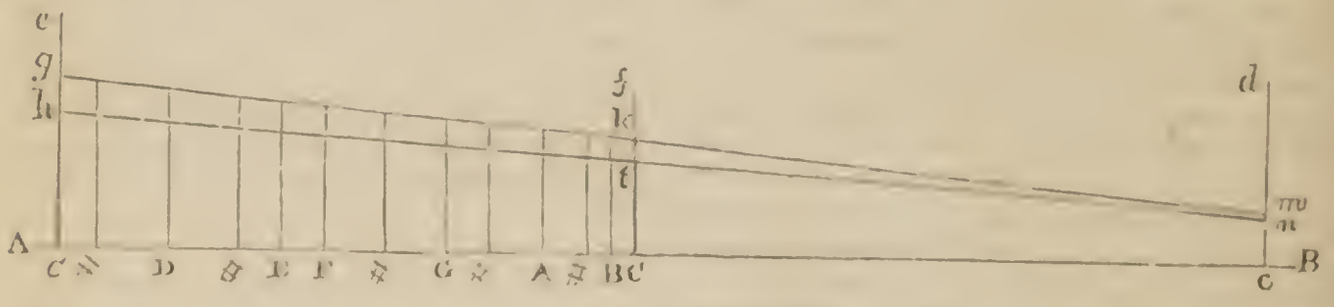
no less than forty individuals having been found prior to 1828. The Italian geologist, Brocchi, says, that such is the quantity of elephants' bones, that the Val d'Arno is like a vast cemetery of these gigantic animals; and that before the peasants learned to keep these relics for sale to the curious, they used to enclose their gardens with legs and thigh-bones of elephants.

When the ancients discovered any of these bones, they considered them to be the remains of a race of giants. Pliny talks of human skeletons twenty-four feet high. Kircher describes the skeleton of Pallas, slain by Turnus, as higher than the walls of Rome; and one of the Cyclops, probably Polyphemus himself, as having been somewhere about 300 or 350 feet high. The same author, and others of great respectability, give us the measures of other colossal personages; and when we reflect, that the credulity and misrepresentation that are here so glaring, are not the errors of the weak and illiterate, but men of learning and men of talents, of the best instructed by reading, by conversation, and by travel, of any of the ages in which they lived, we cannot but be struck by the difference between the criterion of truth, as received in those days, and at the present time; a diversity referrible to divers causes, but to none more than to the progress of natural and experimental science in modern, and more particularly in our own times.

TO CONSTRUCT A SCALE FOR WOODEN ORGAN PIPES.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Enclosed is an answer to "L. V.," and, as some other of your correspondents have asked questions relative to the same subject, perhaps you may think it worth publishing.



Draw a line, A B; at one end, B, raise a perpendicular, *c d*, and measure off, *c* C, 11¼ inches; raise another perpendicular, *C e*. Bisect *C c* at c. and raise a third perpendicular, c *f*; take *C g*, 1⅝ inches, and *C h*, ⅛th less; also, c *k*, ⅔ths of *C g*, and c *l*, ⅓th less than c *k*. Through the points *g* and *k*, draw the line, *g k m*, and through *h* and *l*, draw the line, *h l n*. Then measure off the following:—

c to sharp next the *C*	10⅞	inches	And draw perpendicular lines as above.
— D	10⅛	—	
— sharp	9⅜	—	
— E	9	—	
— F	9¼	—	
— sharp	8	—	
— G	7⅝	—	
— sharp	7⅛	—	
— A	6¾	—	
— sharp	6⅜	—	
— B	6	—	

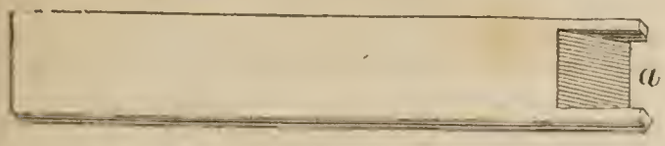
To continue the scale lower, extend the lines, *m g* and *n h*; and for any note, double its distance from *c*, will be the place to draw the line. To continue the scale higher, take half the distance of any note from *c*, and draw the perpendicular.

Use of the Scale.

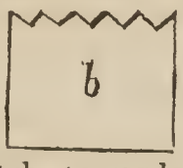
Wooden pipes are usually made deeper from back to front, than from side to side; therefore the blocks, which are to be first cut out, are to be made the size of the perpendicular lines standing over any note (*C*, for instance); one way equal to *C h*, and the other way equal to *C g*.

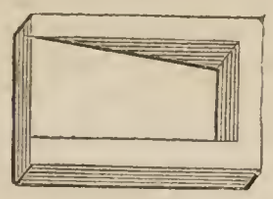
The blocks should be of hard wood, and perfectly dry. Slips of thin wood should then be cut to form the sides of the pipes, equal in width to the block the widest way, and the length of about three inches more than from *c* to the note being made, as the part from *c*, towards the left hand, is the length of the speaking part. The back must then be made of the width of the block the narrowest way, *plus* twice the thickness of the wood used for the sides. When these parts are glued together, the fronts can be made, which

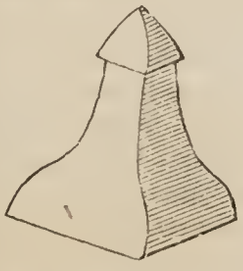
must be of the same width as the backs, but not longer than the speaking parts. They must have the mouths cut, something after the following fashion :—



The part, *a*, that is wholly cut away, should be as deep from the end, as the part of the perpendicular line cut off by slanting lines, *g m* and *h n*—that is, one-fifth of its width. The blocks must then be scored down with regular and even, but shallow, grooves, about the depth of the annexed figure ; *b*, being a section of the block, little pieces of hard wood, called caps, of the following form, must then be glued on, having the side, seen in the sketch, towards the block, and the end, *x*, towards the mouth of the pipe; a flat piece must then be glued on to the lower end of the pipe, with a piece of wooden pipe inserted in it to convey the wind. Lastly, plugs must be made of soft deal, of the following form, having the bottom part of the same size as the block, for the pipe it is intended to stop. This must be covered on the bottom and sides with leather, to make it fit tight. Its use is to plug the upper ends of the pipes; and it is by these plugs they are tuned.







The proper leather for organ bellows, is the white sheep skin ; as it is soft, cheap, and air-tight. Of course the sides of the bellows must be made of thin wood, covered with the leather, or they would not retain their form, but blow out, leaving the angles of leather only. When the bellows are very small, good stout cardboard will do instead of wood.

EXTINCTION OF CONFLAGRATIONS IN BUILDINGS AND SHIPS.

The frequency of this calamity, and failure of the means of extinction in numerous instances, invite farther inquiry, and present claims on indulgence towards even feeble attempts at improvements.

General approval through ages having sanctioned throwing water on the fire, the judicious use of this element is of the first importance. The general proceeding has been to bring it in contact with the flame, which, however, is insufficient, because the ignited substances are underneath in a large body, increased by timber, &c., falling in, and may not be reached by the water that had been poured in a stream, wherever flame invited generally in the open air. Thus the solid fire below is feebly acted on, if at all, while it feeds the flame, which, being an effect, is to be overcome only through its source. Such must be the dispersion of the projected water, by falling outside and by heat, &c., that a small portion only can effect any purpose. The dispersion of the water inside, also weakens its force as an extinguisher.

The question arises here—How are these hinderances to be combated? I propose that earthy matters be thrown on the substantial fire, by enclosing them in bags of the size of those for shot, into any apartment where solid fire may appear ; to be wetted beforehand or afterwards. The effect will be, retention of our sole means, water—its concentration and preservation from running off. Also, the communication of fire in any shape will be intercepted. By keeping the bags wetted, the ordinary effect will proceed, as if a wet blanket had been used—namely, the fire will be smothered. Farther, steam will be produced, attended by the following advantages :—It will ascend through all openings, extinguishing as it goes. Also, it will occupy the atmospheric space; thus cutting off a supply, without which fire cannot exist. Fire in the upper rooms will be reached by steam, and more effectually acted on than by water falling on it, as before stated, from outside. The building ought not to be broken down in any part, because air will be admitted, so as to add to the evil, while steam will escape, the confinement of which is so very material: to the latter, the earthy matters avail much.

Many of these suggestions apply to conflagrations in ships, where water fails in most cases, although abundant. The quick dispersion lessens its power, while the fire, being concentrated, predominates over its wasted and weakened antagonist —scattered and evaporating water.

Were hemp cloth, even without earthy matters, to be in readiness in ships, they might be used like a wet blanket to aid extinction, as already mentioned.

In throwing water from engines, flame, spark, and smoke, ought to be passed over, except as guides to solid fire below. The

common practice is as driftless as that of attacking the human head with remedial measures, when its symptoms arise from remote parts, of which the drunkard's appearance is a striking example. It is averred, that small portions of flame may increase the latter in vacuo, by a union of hydrogen gas with caloric. If this is well founded, firemen should withhold undue quantities, until a large supply was at hand. Were a number of soldiers, too few to conquer, and a portion of them likely to join the enemy, to be employed in war, surely the attack should be deferred, until the force had been increased so as to rise above the casualty and to promise success. That an undue proportion of water adds to the flame, in an open space, has, hitherto, been overlooked, yet is material to be known for our guidance. On the whole, if these opinions are correct, the great aim should be, to apply all the water on or near to solid fire, not flame, and to retain it by earthy or other matters, when practicable.

When extinction of fire in a chimney is attempted, a teacupful thrown into the grate every minute will not flow off, steam will be produced and fill the funnel, so as to extinguish promptly. I have witnessed this in two instances; burning soot dropt down instantly on the chimney being filled with steam.—*Mon. Merlin.*

THE STEAM-ENGINE.

The first instance on record of the force of steam being applied to produce motion, is that of the Eolopile of Hero, of Alexandria, who flourished in the reign of Ptolemy Philadelphus, B. C. 130.

A. D. 1125. According to "Malmsbury's History," there was, at Rheims, an organ, in which steam or "heated water," as it is termed in the history, was in some way instrumental in causing the sound; but it does not appear quite clear, whether steam itself was used, or heated water only employed to expand the air.

A. D. 1543. At Barcelona, a Spanish sea-officer, of the name of Blasco de Garay, propelled a vessel without sails or oars, "by an apparatus, of which a large kettle, filled with boiling water, was a conspicuous part."

A. D. 1606. Baptista Porta invented a "steam fountain," for raising water by the force of steam.

A. D. 1615. Solomon de Caus, engineer and architect to Louis XIII., of France, describes a machine for raising water by means of steam; it was, however, only a modification of Porta's machine.

A. D. 1629. Giovanni Branca, an Italian engineer, appears the first who proposed using steam as a moving power. His engine was a sort of steam-windmill, consisting of a boiler, with its spout directed towards a wheel, the vanes of which being struck by the steam from the boiler, caused a continuous motion.

A. D. 1663. Edward Somerset, Marquis of Worcester, describes an engine, which is only an improved plan of Porta's "steam fountain."

A. D. 1683. Sir Samuel Morland exhibited, before Louis XIV., a machine for raising water by steam; but there is no record extant of the particulars of his plan.

A. D. 1690. Denis Papin, a Frenchman, Professor of Mathematics at Marburg, invented an engine in which "a piston, working tight in a cylinder, might be raised by boiling a little water under it; and that, when raised, by cooling and condensing the vapour which had raised it, a vacuum might be formed below it, when the atmospheric pressure would force it down." But his apparatus is almost impracticable on a large scale, being too clumsy and troublesome. He was the first, however, that gave the idea of the atmospheric engine. He was also the inventer of the safety valve and the digester, now in use.

A. D. 1698. Of all those who proposed to raise water by the force of steam applied directly to the water, we must award the greatest share of merit to Thomas Savery, treasurer to the Committee for the Recovery of the Sick and Wounded. He was the first that added the application of atmospheric air to his engine. Savery's engine is a very beautiful and ingenious contrivance. The guage-pipes for ascertaining the quantity of water in the boiler, were his invention, and he applied the safety-valve to the boiler, which was contrived by Papin for his digester.

A. D. 1707. Papin published at Cassel, a tract entitled, "New Method for Raising Water by the Force of Fire." This plan was essentially the same as that of one part of Savery's—that in which water was raised by the elastic force of the steam. The only improvement on Savery's engine was, that he interposed a moveable float or piston between the steam and the water; less steam being thereby lost by condensation. This engine does not possess much merit; not using the steam for making a vacuum,

thereby to take advantage of the atmospheric pressure. It was decidedly inferior to Savery's.

A. D. 1708. Desaguliers made several great improvements on Savery's atmospheric engine; thereby reducing the cost, while the work done by it was increased in proportion.

A. D. 1705 and 1713. The next greatest improvements effected in the steam-engine, were those of Newcomen and Cawley; the former an ironmonger at Dartmouth, and the latter a plumber of the same place. The plans formerly in use were now abandoned, and recourse was had to the method suggested by Papin's first project—viz. that of a piston pressed down in a cylinder by the atmospheric pressure — a vacuum being previously formed below the piston, by filling the space with steam, which was then condensed. This engine was afterwards improved, in many subordinate matters, by the celebrated Smeaton. The adapting to it a crank and fly-wheel, to procure, from the reciprocating vertical motion of the piston, a continued circular motion, was effected about the year 1780. Newcomen's engine, though now superseded by Watt's, ought not to be forgotten; it was a machine of great practical utility, and came into operation about 1712; it continued to be used exclusively for about sixty-two years.

A. D. 1765. James Watt, born at Greenock, about this time introduced his single-acting engine—that is, one in which the piston was only propelled downwards by the force of steam, being pulled upwards by a weight attached to the other extremity of the beam; and in 1782 he added the finishing stroke, and took out his patent for his "double-acting single cylinder engine," the one now in use, and that which may, with propriety, be termed "the steam-engine." W. H. W.

BILBROUGH'S AIR-PUMP.

To the Editor of the Penny Mechanic and Chemist.

Sir,—If your correspondent, "A. M.," will be kind enough to refer to the description I have given of the air-pump, he will perceive that I have not stated that the air can be entirely exhausted from the receiver; but if you, sir, think the drawings require any farther description, I shall feel most happy in giving it to him or any of your correspondents.

Respecting the acidulous properties of oxygen, I beg to inform him, that the researches of modern chemists have shown, that the former opinion of considering oxygen as the acidifying principle of acids, erroneous. Yet every practical chemist is aware, that oxygen is contained in many of the acids belonging to the animal, vegetable, and mineral kingdom, a few of which I will mention:—The phosphoric, nitric, carbonic, muriatic, molybdic, and chromic acids. If the proportions in which oxygen exists in the various acids, will be of any service to "A. M.," I shall take pleasure in forwarding it at my earliest opportunity.

T. R. Bilbrough.

THE CHEMIST.

CHEMISTRY.

EXPERIMENTS SHOWING THE CHEMICAL ATTRACTION OF BODIES.

There are five kinds of attractions—attraction of gravitation, the electric attraction and the magnetic attraction, chemical attraction, and the attraction of cohesion. The following will be found to be experiments on chemical attraction and others.

On copper filings put nitric acid; evaporate, and crystals will be formed. Dip a knife or other steel into the above solutions; on taking it out, it will have received a bright metallic coating of copper; the copper coating being the metal changed back to its natural form.

Water Decomposed—Oxygen combines with Metals, forming Oxides.

In diluted sulphuric acid, put some pieces of zinc; an action commences, forming hydrogen, a component part of water. The water with which the acid is diluted being decomposed, its oxygen combining with the zinc, forms an oxide of the metal; which oxide unites with the sulphuric acid, being a sulphate of zinc, while the hydrogen of the water goes off as a gas.

Ether converted into Vapour by the Air-Pump.

In a glass bottle place ether; exhaust, and the above will be proved. Dissolve, in a certain quantity of water, some muriate of lime; add a few drops of sulphuric acid, forming a solid body.

Intense Cold formed by the Evaporation of Ether in an Exhausted Receiver.

Single electric affinity is, when certain bodies have not the same affinity towards others, but attract unequally. If we add

muriatic acid diluted to some pieces of marble—the component parts of which are carbonic acid and lime—the latter combines with the muriatic acid, having for it more affinity than for the carbonic, which, being separated, forms muriate of lime in solution. Sulphate of lime may also be procured, by adding sulphuric acid to the muriate of lime; the acid being attracted by the lime, in preference to the muriatic. Sulphate of lime will fall, and the muriatic acid will be set free.

The foregoing being rather a complicated affair to be understood by many, a second, and, perhaps, one that can be better understood, will be acceptable :—

The three acids in question—namely, muriatic, carbonic, and sulphuric acid—of these three, lime has the most affinity for the sulphuric, and the least for the carbonic acid ; thus showing the choice of election. The affinity the lime has for the sulphuric acid, is called electric. Thus comes *single electric affinity*.

Double Electric or Complex Affinity.

This is when two compounds, acting upon each other, form new bodies. " Make a solution of sulphate of soda (the former being of sulphuric acid and soda, the latter of muriatic acid and lime), the sulphuric acid of the sulphate of soda will unite with the lime of the muriatic, and form sulphate of lime." In like manner with the opposite compounds—the muriatic uniting with the soda of the sulphate, forming muriate of soda in solution.

This example may, perhaps, be more thoroughly comprehended by the following :—

Muriate of soda.

Sulphate of soda. { Soda — Muriat. acid. / Sulph. acid. — Lime. } Muriate of lime.

Sulphate of lime.

THOS. FULLER, Jun.

Vauxhall.

(To be continued.)

FORMATION OF WATER BY COMBUSTION.

To the Editor of the Penny Mechanic and Chemist.

SIR,—Water being one of the most useful articles for promoting the happiness and comfort of man generally, it may be a pleasing experiment to some of your readers, to be able themselves to form that useful ingredient of health, without which all things must cease to exist. In some small vessel, set on fire some alcohol or spirits of wine, over which place a tumbler or bell glass. On removing the same, a condensed vapour will be found to be on the sides of the glass, being pure water formed by combustion. Should you find this worthy of insertion, you will oblige

Yours most respectfully,

T. FULLER, Jun.

A HOLLOW FLAME.

To the Editor of the Penny Mechanic and Chemist.

SIR,—I believe it is not generally known, that the flame of spirits of wine is hollow ; any one doubting this, may be well assured of the same by the following experiment: —In a teaspoon, or some such vessel, put spirits of wine or alcohol ; it being lighted and allowed to burn some seconds, quickly place in the middle of the flame, as near as possible, a dry Congreve match ; the latter will not ignite, whatever length of time it may be in that position.

I remain yours, &c.,

T. FULLER, Jun.

COMBUSTION.

(Continued from page 54.)

THE light emitted during combustion, must either proceed from the combustible or the supporter. That it proceeds from the combustible, must appear pretty obvious, if we recollect that the colour of the light emitted during combustion varies ; and that this variation usually depends, not on the supporter, but on the combustible. Thus, charcoal burns with a red flame, sulphur with a blue or violet, zinc with a greenish white, &c.

The formation of combustibles in plants, obviously requires the presence and agency of light. The leaves of plants emit oxygen gas, when exposed to the sun's rays, but never in the shade or in the dark.

Besides vegetation, we are acquainted with two other methods of *unburning* products, or of converting them into products and combustibles, by exposing them, in certain circumstances, to the agency of fire, or of electricity. The oxides of lead, mercury, &c., when heated to redness, are decomposed, oxygen gas is emitted, and the pure metal remains behind. In this case, the necessary caloric and light must be furnished by the fire ; a circumstance which explains why such reduc-

tions always require a red heat. When carbonic acid is made to pass repeatedly over red-hot charcoal, it combines with a portion of charcoal, and is converted into gaseous oxide of carbon. If this gas be a combustible oxide, the base of the carbonic acid and its oxygen must have been supplied with light and caloric from the fire; but if it be a partial combustible, it is merely a compound of carbonic acid and charcoal: which of the two it is, remains still to be ascertained.

Electricity decomposes water, and converts it into oxygen gas and hydrogen gas; it must, therefore, supply the heat and the light which these bodies lost when converted into a product.

These facts, together with the exact correspondence of the theory given above, with the phenomena of combustion, render it so probable, that Dr. Thomson has ventured to propose it as an additional step towards a full explanation of the theory of combustion. Every additional experiment has served to confirm it more and more. It even throws light upon the curious experiments of the accension of metals with sulphur, which succeed in vacuo, under mercury, in nitrogen gas, &c.

Dr. Thomson has noticed, that the same emission of caloric and light, or of fire, takes place when melted sulphur is made to combine with potash or with lime, in a crucible or glass tube, and, likewise, when melted phosphorus is made to combine with lime heated to redness. He supposes that, in all probability, barytes and strontia exhibit the same phenomenon when combined with melted sulphur or phosphorus; and, perhaps, some of the metals, when combined with phosphorus.

The phenomena Dr. Thomson explains thus:—The sulphur and phosphorus are in the melted state, and, therefore, contain caloric as an ingredient; the alkalies, earths, and metals, which produce the phenomenon in question, contain light as an essential ingredient. The sulphur or phosphorus combines with the base of the metal, earth, or alkali; while, at the same time, the caloric, to which the sulphur or phosphorus owed its fluidity, combines with the light of the metal, earth, or alkali; and the compound flies off under the form of fire.

Thus the process is exactly the same with combustion, excepting as far as regards the product. The melted sulphur or phosphorus, acts the part of the supporter, while the metal, earth, or alkali, occupies the place of the combustible. The first furnishes caloric, the second light; while the base of each combines together. Hence we see, that the base of sulphurets and phosphurets resembles the base of products, in being destitute of light; the formation of these bodies exhibiting the separation of fire, like combustion; but the product differing from a product of combustion, in being destitute of oxygen, Dr. Thomson distinguishes the process by the title of semi-combustion; indicating, by the term, that it possesses one-half of the characteristic marks of combustion, but is destitute of the other half.

The only part of this theory which requires proof is, that light is a component part of the earths and alkalies. But, as potash and lime are the only bodies of that nature, which we are certain to be capable of exhibiting the phenomena of semi combustion, the proofs must of necessity be confined to them. That lime contains light as a component part, has been long known. Meyer and Pelletier observed long ago, that when water is poured upon lime, not only heat, but light is emitted. Light is emitted also abundantly, when sulphuric acid is poured upon magnesia, or upon lime, potash, or soda, freed from water of crystallization. In all these cases, a semi-combustion takes place. The water and the acid being solidified, give out caloric, while the lime or potash gives out light.

That lime, during its burning, combines with light, and that light is a component part of lime, are demonstrated by the following experiment, for which we are indebted to Scheele:—

Fluor spar (fluate of lime) has the property of phosphorescing strongly when heated; but the experiment does not succeed twice with the same specimen. After it has been once heated sufficiently, no subsequent heat will cause it to phosphorate. Now phosphorescence is merely the emission of light: light, of course, is a component part of fluor spar, and heat has the property of separating it. But the phosphorescing quality of the spar may be again recovered to it, or which is the same thing, the light which the spar had lost, may be restored by the following process:—Decompose the fluate of lime by sulphuric acid, and preserve the fluoric acid separate; boil the sulphate of lime, thus formed, with a sufficient quantity of carbonate of soda; a double decomposition takes place: sulphate of soda remains in solution, and carbonate of lime precipitates. Ignite this precipitate in a crucible, till it is reduced to lime, and combine it with the fluoric acid to which it was formerly united. The fluor spar, thus

regenerated, phosphoresces as at first. Hence the lime, during its ignition, must have combined with light.

That potash contains light, may be proved in the same manner as the existence of that body in lime. Now as potash is deprived of its carbonic acid by lime, the Doctor supposes that the process must be a double decomposition—namely, that the base of the lime combines with carbonic acid, while its light combines with the potash.

These remarks on semi-combustion might easily be much enlarged upon. For it is obvious, that whenever a liquid combines with a solid containing light, and the product is a solid body, something analogous to semi-combustion must take place. Hence the reason why water increases the violence of combustion, when thrown sparingly into a common fire, &c.

ON THE MANUFACTURE OF BRITISH WINES.

It appears, from the comparison of experiments made by chemists, who have examined the quantity of alcohol to be obtained from the fermented liquors now mostly in use, that the wines of the present day are much stronger than they were about eighty years ago, at least in England; and this is owing, probably, to the addition of brandy.

The fermentation of liquors is generally hastened by the addition of yeast or cream of tartar; but this is seldom necessary for wines, if the liquor be kept in a proper warmth, as they are not so sluggish as malt liquors.

If the fermentation is in danger of proceeding too far, it may be stopped by drawing off the liquor clear into another barrel in which brimstone has been newly burned; or, in the case of red wine, some nutmeg powder upon a hot shovel, or which has been washed with brandy. The sediment left in the old cask may be strained through flannel or paper till clear, and then added to the other.

Instead of this a part only may be drawn out of the cask, and some rags, dipped in melted brimstone and lighted, may be held by a pair of tongs in the bung-hole, slightly covered, so as to impregnate the liquor with the fumes; then returning what had been drawn out, and bunging it up very close. Or, a small quantity of oil of vitriol may be poured in. Lastly, the addition of black oxide of manganese has been proposed, on theoretic grounds.

If the fermentation has already proceeded too far, and the liquor become sour, the farther fermentation must be stopped as above, and some lumps of chalk added to saturate the acid already generated.

If the liquors do not become clear soon enough, for each thirty-six gallons, dissolve one ounce of isinglass in two pints of water. Strain and mix this with part of the liquor; beat it up to a froth, and pour it into the rest of the liquor; stir the whole well and bung it up. Instead of isinglass some use hartshorn shavings in a rather larger quantity.

Red wines are fined with eggs, twelve to a pipe, beaten up to a froth, mixed with the wine, and well stirred in.

If the liquor has acquired a bad flavour, the best way is to let the fermentation go on, and convert it at once into vinegar.

Wines may also be made of blackberries and other English fruits, upon the same principles. The above are the methods generally employed; but most persons have peculiar ways of proceeding, which may indeed be varied to infinity, and so as to produce at pleasure a sweet or dry wine; the sweet not being so thoroughly fermented as the dry. The addition of brandy destroys the proper flavour of the wine, and it is better to omit it entirely (except for elder or Port wine, whose flavour is so strong that it cannot well be injured), and to increase the strength by augmenting the quantity of raisins or sugar. In general, the must for wines ought to be made of raisins 6lbs., or sugar 4lbs., to the gallon, allowing for that contained in the fruit; and in most fruits, especially the black currant, it is advantageous to boil them previously to making them into wine, as this improves the flavour greatly.

Wines are usually doctored, as it is called, in order to give them peculiar flavours, and render them similar to some celebrated grape wines. Thus bitter almonds are added to give a nutty flavour; sweet briar, orris root, clary, cherry, laurel water, and elder flowers, to form the bouquet of high-flavoured wines; alum, to render young and meagre red wines bright; Brazil wood, cake of pressed elderberries and bilberries, to render pale faint Port of a rich deep purple colour; oak sawdust, and the husks of filberts, to give additional astringency to unripe red wines; and a tincture of seeds of raisins to flavour fictitious port wine. Wine is coloured with red beet, but in this case it is rendered colourless by lime-water. Genuine red wines yield a greenish grey precipitate, with a solution of sugar of lead; but those coloured with bilberries, elderberries, or logwood, give deep blue precipitates; and those coloured by Brazil wood, red sanders, and red beet, red precipitates. Gypsum is used to clear cloudy wines, as also lime; and the size of a walnut of sugar of lead, with a tablespoon-

ful of sal enixum, is put to forty-two gallons of muddy wine to clear it; and hence, as the sugar of lead is decomposed, it is changed into an insoluble sulphate of lead: the practice is not so dangerous as has been represented by those afflicted with the poison mania.

WEIGHT OF ACIDS.

The strength of liquid acids is usually expressed in England by the enunciation of their specific gravity, water being considered as unity; and in France and the neighbouring countries, by the degrees of Baume's hydrometer, on account of its easy construction; but this does not answer for all acids, for the experiments of Molerat, a manufacturer of acetic acid, showed that the strength of acetic acid cannot be determined by the mere consideration of its specific gravity; and the case is probably the same with some other acids formed in or from organic bodies.

Hence the French chemists have introduced a fictitious standard, founded upon the capability of the acid to saturate a determinate weight of well crystallized subcarbonate of soda: the quantity of pure sulphuric acid (36 parts) necessary to saturate 100 parts of subcarbonate of soda, being esteemed as 100 acidimetric degrees. Then if, upon trial, 88 grains of any other acid be required to saturate 100 grains; or, for the sake of using smaller quantities, 22 grains should saturate 25 of subcarbonate of soda; then, as 88 (22) of the acid is equivalent in force to 36 (9) of sulphuric acid, so, by inverse proportion, are 100 acidimetric degrees to 40 deg. ·99, the conventional strength of the acid assayed, which may be quoted as 41 acidimetric degrees strong.

There are other modes of calculating the strength of acids in this mode of valuation, which is substituted for the equivalents of Dr. Wollaston, with a view of rendering the calculations more adapted to the habits of practical men.

As the power possessed by 36 parts of oil of vitriol to saturate 100 parts of dry subcarbonate of soda is taken to represent 100 degrees of strength, so if 36 parts of any other acid liquor are taken, the number of the parts of subcarbonate that it will saturate is at once the expression of its acidimetric strength; thus, as a solution of 36 grains of crystallized acetic acid will saturate 90 grains of the subcarbonate of soda, this 90 is the expression of its acidimetric strength. The acidimetric strength of an acid may also be estimated from the saturation of any determinate weight of subcarbonate by a determinate weight of acid: for example, 100 grains of the acidum nitricum of the London Pharm. ought to saturate 212 grains of subcarbonate: then as 100 grains of acid are to 212 grains of alkali, so are 36 grains of acid representing 100 degrees of strength to the strength of the nitric acid, which will be found to be 76 deg. ·32: and in like manner, as 100 grains of the acidum muriaticum are required to saturate 124 grains of subcarbonate of soda, its strength, expressed in the French mode, will be found to be 44 deg. ·64.

If the strength of any acid be given in acidimetric degrees, the quantity of subcarbonate of soda that any assigned weight of it will saturate is thus found. As 36, the standard quantity of oil of vitriol taken to represent 100 degrees of strength, is to the quoted strength of the acid, so is the weight of the acid intended to be used to the weight of the subcarbonate that it will saturate. For instance, let it be required how much subcarbonate of soda 100 grains of acetic acid, from wood at 31 deg. ·32, will saturate; then, as 36 are to 31·32, so are 100 to 87, the number of grains of subcarbonate that the acid will saturate. And this is the number quoted by the London college as the power of saturation that their acidum aceticum fortius ought to possess.

The use to be made of this mode of valuation may be thus exhibited. Having 1500lbs. of rectified pyroligneous acid 8 acidimetric degrees strong, how much crystallized sulphate of soda will be required to be added to the pyrolignite of lime formed by this quantity of acid to convert it into pyrolignite of soda? It is known that every 20lbs. ·25 of sulph. of soda contain 5lbs. of dry sulphuric acid, which, with 1 lb. ·125 of water, would form 6lbs. ·125 of oil of vitriol, at 66 deg. Baume, or 100 acid degrees. Now 1500 lbs. of pyroligneous acid multiplied into 8 deg. of strength, will give for its total strength 12,000 deg.; and 6 lbs. ·125 of oil of vitriol multiplied into 100 deg. will give for the total strength of each 20 lbs. ·25 of sulphate of soda, 612 deg. ·5. Hence, if 12,000, the total strength of the pyroligneous acid, be divided by 612 ·5, the quotient, 19·595, or say 19·6, will show how many times 20lbs. ·25 of sulphate of soda must be employed; which will be found equal to 398lbs.

MANUFACTURE OF PHOSPHORUS.

For some time phosphorus was made in very inconsiderable quantities, and by a tedious and disagreeable process, consisting in evaporating considerable quantities of urine, and decomposing them by various means.

The following processes, now employed, are more easy and expeditious :—

Pour a concentrated solution of nitrate of lead, by a little at a time, into a quantity of urine, until no more cloudiness is produced by a farther addition of the solution. The mixture is then to be diluted with soft water, and suffered to stand undisturbed ; when the precipitate is fully subsided, the clear fluid is to be separated. The precipitate is then formed into a paste, with charcoal powder, and the mass is to be dried gradually in an earthen pan, and submitted to distillation.

In this process the phosphoric acid of the urine unites to the lead of the nitrate of lead, and the nitric acid joins to the ammonia and soda of the urine; hence phosphate of lead and nitrate of soda and ammonia are formed. The former, being insoluble, falls to the bottom, and the latter salt remains in the super-natant fluid. On adding charcoal to the phosphate of lead, and exposing it to a high temperature, the union is again broken ; the phosphoric acid becomes decomposed, its oxygen unites to the charcoal, and forms carbonic acid gas, which flies off during the distillation ; the phosphorus appears in its simple state, and the metal is left behind in the retort, together with the superabundant quantity of charcoal.

Another Process.—Take a quantity of bones of adult animals, burn them to whiteness in an open fire, and reduce them to a fine powder. Upon three pounds of this powder, after having been put into a matrass, there may be poured two pounds of pure sulphuric acid ; four or five pounds of water must be afterwards added by degrees, to assist the action of the acid. During the whole process the operator must place himself and the vessel so that the fumes of the mixture may be blown from him. The whole is then to be left in a gently-heated sand-bath, for about twelve hours, or more, taking care to supply the loss of water which happens by evaporation. The next day a large quantity of water must be added, the clear water afterwards decanted, and the rest strained through a cloth or sieve. The residuary matter is to be edulcorated by repeated effusions of hot water, till it passes tasteless. The water which has been used to wash out the adhering acid is mixed with the before-decanted or strained liquor, and the whole fluid is gradually evaporated in a flat earthen basin, to the consistence of syrup. It is then to be mixed with an equal weight of charcoal powder, and submitted to distillation in an iron or earthen retort. Instead of applying a receiver, the neck of the retort may be immersed in a basin of water, to a small depth, and the phosphorus, as it comes over, will fall in drops to the bottom.

In this process the sulphuric acid unites with the calcareous earth of the bones, and forms sulphate of lime ; and the phosphoric acid of the bones becomes disengaged, and remains dissolved in the liquor. The charcoal, at an elevated temperature, takes the oxygen from this acid, and carbonic acid gas is formed, and phosphorus passes over.

Phosphorus obtained by either of these processes is of a dirty blackish colour, and soiled with a certain quantity of charcoal and half-burnt phosphorus, which gives it that appearance. In order to purify it, it must be put into a piece of chamois leather, and closely tied up in it. The whole is then immersed in a vessel of boiling water ; the phosphorus melts, and may be pressed through the leather, taking care to keep it under the water.

It is better, however, to purify phosphorus by a second distillation.

In order to form phosphorus into sticks, a funnel with a long neck may be used, the lower orifice of which is closed with a cork ; the funnel is then to be filled with water, and phosphorus put in it; and this being plunged into boiling water, the heat communicated to the funnel melts the phosphorus, which runs into the neck, and acquires that form. The funnel is then removed into a vessel of cold water, and when it is thoroughly cooled, the cork is taken out, and the phosphorus thrust out of its mould with a piece of wood, and then preserved in water.

Another method has been invented, which is as follows :—

Take a few tubes, of any length, the apertures of which are of such a size that they can be exactly closed with the extremity of the finger. Melt the phosphorus in boiling water, and apply to it one of the ends of the tube, while you hold the other in your mouth ; make a short inspiration, that the phosphorus may ascend a little way in the tube ; stop the inspiration when the phosphorus has risen a sufficient height, and close the extremity of the tube with the fore finger, and immerse it in a basin of cold water. The phosphorus will soon become fixed, and, by a slight shake, may be separated from the tube.

MISCELLANEA.

Protection against Fire-damp in Coal Mines.—If every shaft had a gun-barrel gas-pipe (a term of size), fastened to the side from the mouth of the pit to the bottom, in which a small iron rod was inserted, the rod, fastened to a lever (like a handspike) at the top, and at the bottom to a percussion lock, and a pistol barrel, with a small quantity of gunpowder rammed down with tow, dipped in spirits of turpentine or naphtha, any one could get to the wire, whose gravity alone would discharge the pistol, which would at once ignite the "fire-damp," and cleanse the pit; so as to make it not only safe for any one to enter with a lighted candle, but wholesome for the men to work in. Were the same apparatus extended to the different gates, banks, or boards, and heading to the coal-pit, the same results would take place. When the men left work, some one should be employed to load the pistols, or see that they were fired morning and evening, before the men went into the mine. The whole could be done with perfect ease at the top of the pit, and carried into every part of the mine; if the mine is very extensive, reaching several miles in various directions, there must be several stations, several levers and pistols, and the levers will have to draw in a horizontal position, instead of only letting them go, as at the top. By this simple means, at a few pounds expense, every mine, whether of coal, iron, or lead, may be rendered perfectly wholesome to breathe; and, at the same time, no accumulation of the deadly carburetted hydrogen gas can be found of sufficient force to blow out a rushlight.—*M. Scales: Athenæum.*

Railway-Train Arrester.—A fresh achievement of the infant science of electro-magnetism, was made known to a select few of the Polytechnic Institution last week. To sound the depths of the sea, to register the march of Time, to communicate thought, and print it with lightning speed—these were known to be *faits accomplis* by electro-magnet power: it now puts forth its arm to arrest the apparently resistless momentum of railway-trains. Assuming that the magical wires, through which the mysterious power is transmitted, are laid down, nothing more is required to do this, than a small voltaic battery, placed on the engine in connexion with an electro-magnet, some clock-work, and a pilot locomotive in advance of the train. It is through this "pilot" that the communications of the wires with the battery are made. When in motion, the connexion is broken by the application of Watt's contrivance of the "governor." Should any obstacle stop the pilot, the arms of the governor fall, and the connexion being then made, the electro-magnet comes into play most effectively. Its first act is to point the hand of a dial to the word "danger." Should the engineer not see this warning, a bell rings to rouse him. Should he be asleep or drunk, the next operation of the apparatus is to put down the breaks; lastly, to turn off the steam, and thus stop the train before it reaches the *avans coureur.* These effects would be produced at a distance from the pilot of two miles; though 300 or 400 yards is the farthest contemplated as practically useful. To explain the *modus operandi*, so far as to be generally comprehensible, would require long descriptions and diagrams: it is enough here to state, that the inventer showed, by his explanations and models, that the thing can be done. Whether it will be done, we doubt. The first expense of laying down the wires and the pilot-engine, will make railway directors question the practicability of the plan. The invention is, however, a step towards dispensing with the services of engine-drivers, by making the locomotive self-acting. If Mr. Bain, in his next researches, should discover electro-magnetic engineers, he will find more favour in the eyes of passenger-propelling companies.—*Spectator.*

Thames Tunnel.—The contract for the erection of the circular staircases for foot-passengers, and also the carriage-ways, has been taken by Messrs. Grissell and Peto, and will be commenced forthwith. The labours of Sir I. Brunel, as regards the tunnel itself, are completed—the key brick of the last arch on the Middlesex side, was inserted by the King of Prussia, on his Majesty's visit. About the second or third week in April, the Thames Tunnel will be finally opened to the public, who will be enabled to pass from one side of the river to the other, on payment of a small toll, which has not yet been fixed. About 3000 passengers cross the ferry daily, between Wapping and Rotherhithe, in the small boats, and the number of persons who will avail themselves of the new line of communication under water, when the tunnel is opened, will, probably, be trebled.

Chinese Streets.—Some of the streets through which I passed were rather broad, and all were paved with loose flag, not cemented together. The different trades appeared to have their particular streets; the dyers were in one part of the town,

the braziers in another, and so on. Some of the shops were very well set off, and all quite open to the street. The houses were mostly built of wood, and the names and occupations of the owners were painted up and down the door posts in yellow and other colours; some being gilded, which gave the streets a gay appearance. Here and there was an opening, where a joss-house stood; the pillars and other parts of the front were gaudily painted and ornamented, and on the roof were placed several images.—*Recent Imprisonment in China.*

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, Mar. 2, Quarterly General Meeting. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, March 3, Edward Cowper, Esq., on the Manufacture of Pottery and Porcelain. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Feb. 28, C. Lane, Esq., on Plans proposed for Human Progress. At half-past eight.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, March 1, Mr. W. Butt, on the Destruction of Jerusalem. At eight o'clock.

QUERIES.

In what book can I find the most information respecting the processes of sugar refining, and more particularly treacle manufacturing, or the ingredients used in manufacturing wash for the distillery? R. Carter.

Where can I purchase the plated silver for the Daguerre process, and at what price; the silver I purchase here has tin in the plating? likewise the method of silvering copper for the same process? Experimenter.

Required the sides of three right-angled triangles in whole numbers, such that their areas shall be all equal to each other. X.

The best way to join small articles of cutlery—such as ladies' scissors, penknives, or surgical instruments, without brazing; as I find that that softens them and renders them useless? H. J.

Is there any means of employing the camera obscura, so that a person may take drawings from his own person? Also, how many are the three bars of iron suspended from a ring, in order to raise stones in building? J. L. D.

How to make a machine by which I can reduce potatoes into pulp, for the purpose of making potato flour? T. Carter.

ANSWERS TO QUERIES.

"W. F." To gain the starting power, the atmosphere is compressed to 100 lbs. the square inch in the air-box. A certain quantity of this being let into the cylinder, it drives the piston-rod up: it is only a supposition. I do not expect it to work in its present state; my chief object being to endeavour to throw out some hint whereby some one more fortunate than myself may make the discovery. F. Baxter.

"J. W. P." The notes for the accordion can be purchased at Reisner's, in the Lowther Arcade, or at Simpson's, in Regent Street.

"C. R." The seraphine keeps in tune much better than the organ, which requires to be constantly attended to; but the seraphine scarcely ever. The plates can be purchased separately, even a single note, at Tulley's, 30, Belton Street, Long Acre. Also any parts of organs. He is a working man, and makes them well.

G. S., Jun.

"H. C." may obtain oxygen from nitrate of potash, by exposing it to a red heat in a retort, or in a gun-barrel; but, at the same time, a portion of nitrogen will be evolved. He will find the black oxide of manganese much better, from which it may be expelled, by exposing it to a gentle heat in a retort, with about half its weight of concentrated sulphuric acid, or by placing some of the dry oxide in a gun-barrel, and thrusting the end containing it in a common fire. Let a small portion escape at first, or it will be mixed with atmospheric air. H. Briant.

TO CORRESPONDENTS.

W. H. *will find the method of preparing the permanent ink at page 40, No. 8, of the present volume. It should be one drachm of nitrate of silver, instead of one grain.*

J. N. S.—*In answer to his query, we have inserted an article on phosphorus, in which he will, no doubt, gain the requisite information. The seven volumes of the* Penny Mechanic *already published, may be had of Berger, Holywell Street, Strand.*

C. G. C. *may also obtain any of the back Numbers or Volumes at the publisher's, in Holywell Street.*

We are constantly receiving queries for insertion, which have been already answered in previous Numbers, and frequently only two or three Numbers before. We shall, of course, be glad to refer our correspondents to any Number for information, but on any ordinary subject, which is almost sure to be found in the pages of the Magazine, it would save them time, and ourselves unnecessary trouble, if they would look over the indexes before writing.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

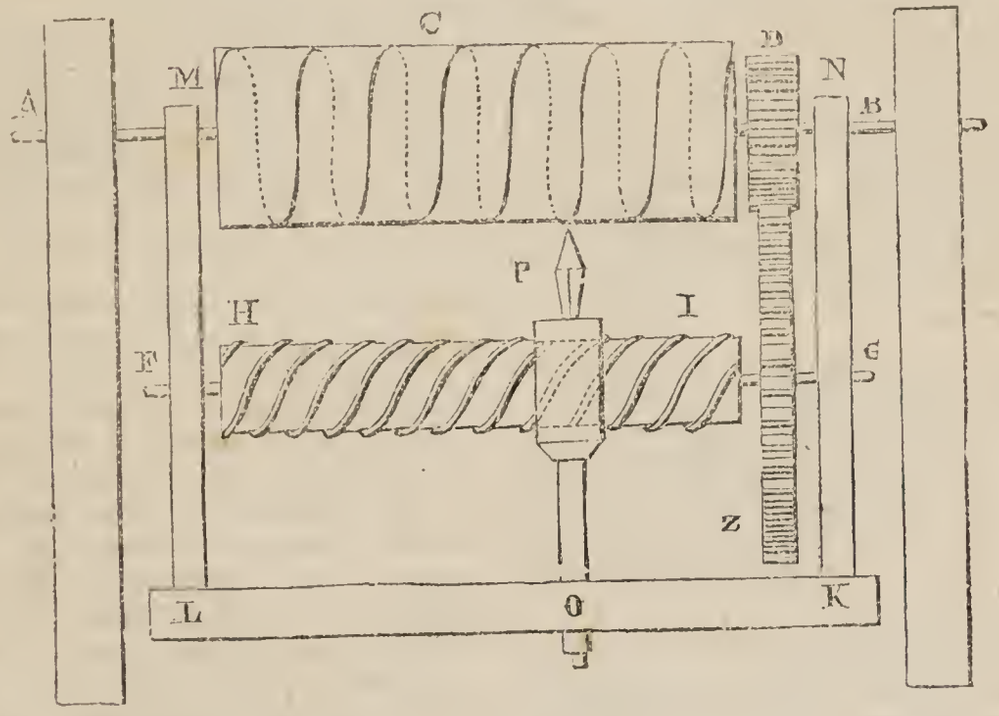
AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 70, THIRD SERIES. | SATURDAY, MARCH 5, 1842. | No. 318, OLD SERIES.

CUTTING SCREWS IN THE LATHE.

FIG. 1.



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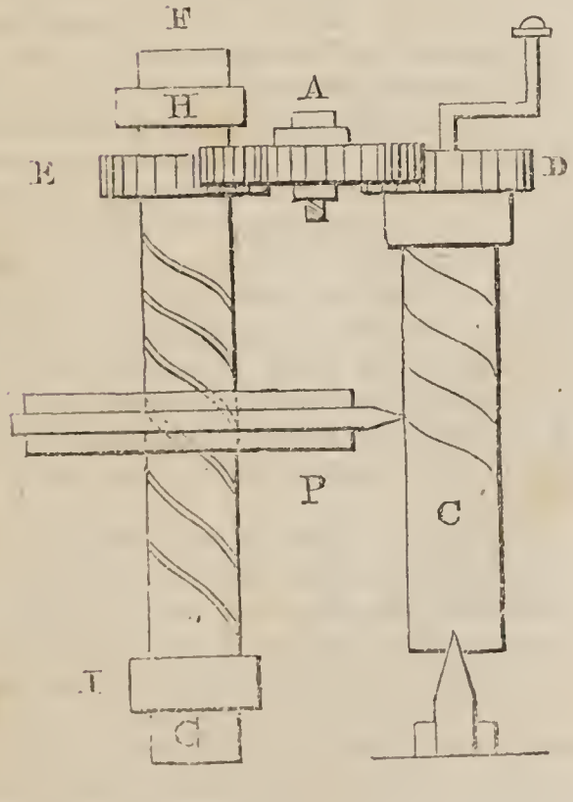

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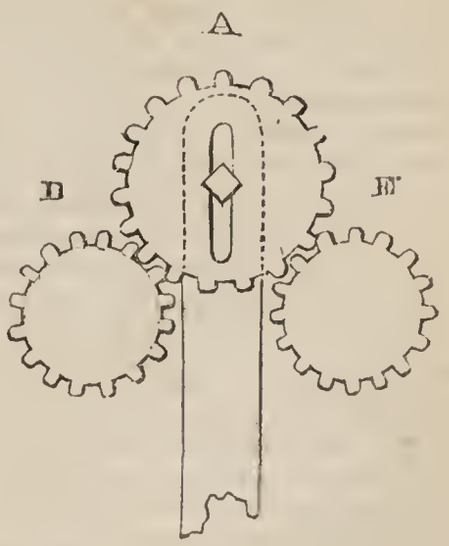

Vol. VIII.—No. 11.] [City Press, 1, Long Lane, Aldersgate Street: D A. Doudney.

ON CUTTING SCREWS IN THE LATHE.

No. I.

(See Engraving, front page.)

1. The art of cutting screws in a lathe, is not only a curious, but an extremely valuable and useful application of turning—inasmuch, that it offers almost the only certain method of producing a screw sufficiently accurate for most practical purposes; hence it becomes important to the mechanic to know, first, the principles on which the art depends, and, secondly, the various mechanical arrangements* which have been devised to effect the proposed end.

2. The first part of our inquiry includes a consideration of *circular motion converted into direct curvilinear*,† from whence we deduce this problem. To describe a continuous spiral on the convex surface of a given cylinder, or, in other words, to trace the helix or thread of a screw of a given diameter.

Let A B, fig. 1, represent a fixed axis, which carries the cylinder, C—on the convex surface of which it is required to describe the spiral—and the toothed wheel, D. M L K N is a frame having a rotary motion on the fixed axis, A B. Between the arms, L M, K N, is suspended the axis, F G, which has a movement of rotation on itself, and carries a toothed wheel, Z, which drives the wheel, D, and, likewise, a male screw, H I, with its nut, P; this nut carries an arm, O P, at right angles to the axis of the screw; the extremity, O, of this arm, moves in a groove, which extends longitudinally through the extent of the bar, L K, of the frame, and, at the other extremity, carries a chasing or cutting tool.

To illustrate this arrangement mathematically, let us designate the radius of wheel, Z, by the symbol, α; that of the wheel, D, by β, and let the thread of the screw cut on cylinder, H I, be called δ. If, now, the frame, M L K N, be made to describe one revolution about the axis, A B, the wheel, Z, and, consequently, the cylinder, H I, will, in the same time, describe a portion of one revolution about the axis, F G, equal to $\frac{\beta}{\alpha}$, and the cutting tool will, in the same time, traverse a distance equal to $\frac{\delta\,\beta}{\alpha}$, which will represent the quantity measuring the thread of the required screw, or the quantity of one revolution of the helix to be described on the cylinder, C. The value of this quantity may, of course, be varied at pleasure, by suitable alterations in the relation of α to β, or that of δ, by the introduction of different guide screws.

3. The mechanism we have just described, is merely intended to assist the demonstration of the problem, there being many objections to its practical application. In the construction of machinery, particularly of that class called tools, we must always remember, that it is essential to combine the desired effect with simplicity of parts and facility of execution; and, as the distribution of parts must be arbitrary, the object may be attained in many different ways, but most efficiently by him who, having calculated all the practicable combinations of which the component parts of a given machine are susceptible, and the required number of movements, adopts the least complicated, and, consequently, the most effective.

4. When a spiral is required to impart a traversing motion to a point, it is generally for the purpose of describing a curve on the exterior or convex surface of a cylinder. In such cases, the arrangement is simplified by dividing the movement, or converting it into a circular and a rectilinear motion. A rectilinear movement of conversion may be given to the cylinder on which the spiral is to be

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* The screw-plate, and the screwing stock and dies, will be described hereafter; they are not included in this paper, because the mechanical action of both is entirely dissimilar from the circular movement of a lathe. The principal defect in these otherwise convenient tools is, that the thread of the screw is produced rather by compression than cutting; the friction, also, is enormous, so that it is very difficult to avoid twisting the pin. These, and other minor disadvantages, have been greatly ameliorated by Mr. Whitworth and Mr. G. Bodmer, both of Manchester. An abbreviated abstract of the specification of the former gentleman's patent, is given in "The Inventor's Advocate," No. 96; and the latter's, which are termed oscillating or vibrating, in No. 115; both these inventions are highly ingenious, especially that by Mr. Bodmer, who has succeeded in giving to his dies a cutting action, similar to a tool in a lathe or planing machine. For an account of the mode of making solid and hollow screws for vices, presses, &c., see "Gill's Technological Repository," vol. 6, page 289.

† MM. Lanz and Betancourt state this proposition rather more diffusely. "To convert direct circular motion of uniform velocity, or, which varies by a given law, into that of a curve of given species, direct and continuous, of velocity similar to that of the moving power, either equable or variable, by a given law, and in the same or in different planes of direction."—*Analytical Essay on the Construction of Machines*, 8vo., page 117.

described, in the direction of its axis, while the point or tracing tool moves round it; or the cylinder may receive a rotary motion on its axis, while the tracing-tool traverses in a line parallel to the axis of the cylinder. This latter method is esteemed more convenient, and is, therefore, adopted in screw-cutting engines, especially in those for large dimensions.

The elementary construction of this useful arrangement may be briefly described. In figs. 2 and 3, the former exhibits a plan, and the latter a side, elevation, the letters of reference being the same in both. F G represents the cylinder, by whose action the rectilinear motion is produced, and communicated to the tracing tool by means of its nut, P. It has a rotary motion on its axis, and is secured in its position by the collars, H and I; E is a toothed wheel, keyed upon the upper extremity of the guiding cylinder, F G; and C is the cylinder on which the required screw is to be cut. It is mounted upon centres, and a toothed wheel, D, is keyed, or otherwise fixed on its upper extremity. The cylinders, C and F G, must be set accurately parallel to each other, as the slightest deviation from this position would entirely destroy the truth of the operation. A is a third or auxiliary wheel, which drives the wheels, D and E; this wheel, A, must be so mounted, as to be capable of adjustment, in order to accommodate itself to any requisite change the wheel, D, for the purpose of varying the relation between the radii of the wheels, D and E. If the difference between these should be so considerable, as that the fixed distance of the two cylinders prevents its being effected by the wheels, D and E, themselves, and circumstances render it impossible to change the guiding cylinder; the difficulty may be obviated, by removing the wheel, A, and employing another wheel with a suitable pinion.

5. A rack is sometimes substituted for the guide-cylinder or screw; the rectilinear movement of which is produced by that of the cylinder on which the required screw or spiral is to be cut, by the intervention of bevelled gear. The practical result will be similar to that already described; but as the mechanism is more complicated, and does not offer commensurate advantages, it is rarely, if ever, employed.

6. The requisite rectilinear movement may be communicated to the tracing tool, by means of an inclined plane, which may be so arranged, as to produce every possible variety of screw, by altering the inclination of the guiding plane. The necessary movement may be given to the inclined plane, either by a rack working with a pinion, or by the action of a screw placed at right angles to the cylinder on which the screw is to be cut;* but, it must be remembered, that this mode is not found suitable to the scale of dimensions required for cutting screws of large diameter; yet, for those of ordinary size, it may be applied with facility, and will be found perfectly practicable.

7. If a screw be turned, its ends being adjusted in collars, so as to prevent both its advance or return; and if the nut in which it works be deprived of a rotary, but allowed a free longitudinal, movement, in the direction of the screw; in this case, the circular and rectilinear movements are divided—that is, the circular being converted into the rectilinear, we obtain a compound movement, which is precisely that required for tracing a helical line.

8. The traversing mandrel described in a former volume of the PENNY MECHANIC, is an adaptation, but a very clumsy one, of this compound movement. When, or by whom, the traversing mandrel was first introduced, I have not been able to discover; nor can I find whether it owes its origin to native or foreign ingenuity. The fact of its having been discarded immediately a better, though more expensive, machine was known, is a convincing proof of its limited utility. No mechanic, I apprehend, would willingly employ a mandrel which required *circular* and excluded *conical* collars; because he would know that such an arrangement would soon throw his lathe out of truth, and thereby preclude that delicacy of finish, which is particularly observable in work turned in a lathe accurately adjusted; and, what is of equal consequence, susceptible of retaining the same relative position with regard to the centres, by means of reversed conical collars. Thus, assuming, for a moment, that the traversing mandrel possesses the valuable property of enabling the workman to cut, by its aid, screws of every possible character, it would still prove inferior to the common mandrel for all other purposes; and, were it necessary, I could easily show its vast inferiority; but, as our present inquiry relates only to its merits

* Ferdinand Berthoud describes, in his "Essai sur l'Horlogerie," vol. I, p. 150, a fusee-engine, in which an inclined plane is used to guide the cutting tool, and is moved by a rack and pinion.

as an agent for cutting screws, I forbear. One thing is certain, it requires as many change guide-screws, as there are screws to be cut; each and every guide-screw transferring, as it were, by its rectilinear and circular motion combined, a similar thread to any cylinder properly attached to it.

9. A screw, rigidly and mathematically true, is seldom required, except in some delicate astronomical instruments. So difficult is it to attain perfection in this apparently simple operation, that competent judges declare, anything beyond approximation to truth, hopeless. The late celebrated Mr. Ramsden is said to have expended *fifty guineas* in cutting the main screw of his dividing engine; and the Society of Arts offered, during many years, a *gold medal*, or THIRTY GUINEAS, "for a mode of producing a screw more perfect, than any hitherto known."

A. M.

LATHE-DIVIDING PLATE.

To the Editor of the Penny Mechanic and Chemist.

SIR,—The suggestion of "An Amateur Mechanic," in No. 66 of your valuable Journal, relative to the lathe-dividing plate, may appear good in theory, but, I am afraid, it will not be found to be so in practice; "because of the friction of the screw wearing the teeth of the wheel;" the consequence of which will be, that, in a short time, your correspondent will find, that he will have to turn the screw above 300 revolutions for one of his wheel; and, in proportion as the teeth are worn away, so much more will he have to turn the screw: this being the case, we have no criterion to be guided by for any exact purposes. The above plan was suggested to my mind some time ago, but I rejected it for the reason given above. I am fully aware of the utility of the plan, if that difficulty can be met. Perhaps "An Amateur Mechanic" will study the matter farther, and give the result in a future Number; but as one mend-fault is worth twenty find-faults, I will here give you what appears to me to be a good plan to reduce the evil complained of—namely, make the screw to serve two purposes—viz. an "endless screw," and also, as a "click," which can be done as follows:—Let the frame which carries the screw, be made to move on a centre at one end (either by a conical-headed screw, or by any other means which may be thought best, so that it can be a firm and steady centre; this centre must be in such a position as that the middle, or nearly so, of the screw, shall come in contact with the wheel, as is usually the case. Now all that is required is, to press the other end of the frame carrying the screw, until the screw comes in contact with the wheel, there to be kept in its proper position by means of a set-screw, or by means of a spring. Now let us suppose that we have a wheel on which we want to cut 56 teeth, as is the case with "An Amateur Mechanic;" all that we have to do is, to unset the set-screw (if one be used), lift up one end of the frame sufficiently high to take the endless screw out of gear of the wheel; then, with your other hand, move the wheel round five teeth (an index-point will guide you), and then let the screw fall into its proper position on the circumference of the wheel again; the remaining fractional parts may now be got by using the screw. Thus you see, that much time, in addition to wearing away the teeth of the wheel, will be saved. Any farther explanation I will willingly give, if required.

I remain yours, &c.

A. B.

ROTARY STEAM-ENGINE.

To the Editor of the Penny Mechanic and Chemist.

SIR,—The subject of rotary engines has lately engaged some part of my attention; and, in the summer of last year, while inspecting a marine engine, an arrangement occurred to me very similar to that inserted in No. 66 of your Journal, with this exception—that the valve or valves were hung on axes which passed through stuffing boxes in the side of the outer cylinder, and which were to be kept in their places by means of a weight. I have since ascertained, that the valves of a rotary engine invented by Masterman in 1820, were something similar. There is one formidable disadvantage, however, attending this arrangement and the arrangement of R. Hammond—the motion cannot be reversed. I have, however, contrived a new engine on the rotary principle, of which I purpose making drawings, and a copy of which, when finished, I will send you, if acceptable.

With regard to the general effectiveness of rotary engines, when compared with reciprocating engines, I confess I am much in doubt. I think that it always has been, and always will be, found, that however simple the rotary engine, or comparatively small its first cost, yet it requires more expenditure of steam and

fuel to produce a given result, than a well-made reciprocating engine.

My reasons for this conclusion are as follows :—All force naturally exerts itself in straight lines, and, in proportion as we endeavour to curb this property, the power is diminished. Steam, for instance, if passed through a tube bent in the shape of an arc, will not exert so much force at the mouth as it would if it were passed through a straight line ; it will also return to its original direction, although with diminished force, for it will issue from the mouth in a straight line. The tendency is, therefore, to fly off at a tangent to the circle of motion. Thus, also, in the common sling, as soon as the restraint is removed, by releasing one end, the stone immediately flies off at a tangent to the circle of action.

This principle seems to me to account for the superior amount of duty done by Cornish pumping-engines. Steam-engines seem to be divided into three great classes, each differing in effectiveness, in the amount of work performed in a given time at a given expenditure. First comes the Cornish engine, in which the motion is almost entirely in straight lines ; next the crank, or reciprocating engine, in which the power is first obtained in a rectilinear direction ; and, from the cause which I have stated above, last of all, the rotary engine.

As to the difference in prime cost, I think the matter is often much overrated. Persons are apt to compare a rotary engine with one of the complicated engines of Watt and others ; forgetting that, in order to set the former on a fair footing for comparison with the latter, a condenser, air-pump, &c., must be added. Engines on the rotary principle ought, therefore, to be compared with high-pressure engines, in a manner which will be easily understood by those conversant with the subject. And I really think, that if this were done in an impartial manner, we should find, that the best rotary engines, or those which do most work at the least cost, are, in reality, as complicated as the simple high-pressure engine—that is, they have as many different working parts.

From these remarks you may imagine, that I am not very sanguine as to the merits of the engines in question. I have communicated my sentiments to you, hoping that some others of your correspondents may favour myself and your other readers with their judgments and expectations on this important subject.

I remain yours, &c., W. H.

COMPOSITION FOR SHAVING.

To the Editor of the Penny Mechanic and Chemist.

Sir,—At a time like the present, when there is a "patent shaving-stone," among other inventions, the following "composition for shaving, without the use of razor, soap, or water," which I have transcribed from a work "On Domestic Economy," may not be unacceptable to some of your readers.

"Mix one pint and a half of clear lime-water, two ounces of gum Arabic, half-an-ounce of isinglass, an eighth of an ounce of cochineal, a quarter of an ounce of turmeric root (made into powder), an eighth of an ounce of salt of tartar, and an eighth of an ounce of cream of tartar, together ; boil them for one hour at least, stirring up the mixture the whole time of boiling, and be careful not to let it boil over ; clear it through a sieve ; then add two pounds and a half of pumice stone, finely pulverized. Mix the whole together, with the hands, into one cake, by the assistance of the white of two eggs, well stirred up ; then divide the cake, so made, into twelve smaller cakes ; dry them in the open air for three days ; put them into an oven, of moderate heat, for twenty-four hours, when they will be completely dry and fit for use. Apply them, with gentle friction, to the beard, and they will produce the complete effect of shaving, by rubbing off the hair."

Should any of your correspondents feel disposed to try the experiment, I should be glad to know the result.

I remain yours, &c.,
G. F. Batchelor.

[Some of our readers may, perhaps, be curious enough to try the above experiment ; but we very much doubt its efficacy, and should be sorry to expose our skin to the friction that would be necessary to remove the hair.—Ed.]

IRON.

Iron is the most abundant, as well as the most useful metal : its specific gravity is 7.7 ; but it may be made 7.8 by hammering. Native metallic iron has been found in Siberia and Peru, in such enormous masses, as to preclude all possibility of their being works of art. These masses are perfectly malleable ; they are very similar to meteoric stones, and have, probably, the same origin. These meteoric

stones, some suppose, are cast from craters either in the moon or some of the planets. Many object to this, saying, "How is it that they can overcome their gravity, so as to fall from thence?" There is an immense mass of this kind of iron, which was discovered many years ago in South America, and is supposed to weigh thirty tons. Pure iron is of a blueish grey colour, and, when rubbed, emits a peculiar smell. This metal possesses the curious property of welding. This property is this—that when two pieces are made hot and hammered, they unite together in one solid piece. Platinum is the only other metal which possesses this curious property. This metal, as is generally known, is attracted by the magnet. It can itself be made magnetic, either by friction with another piece already rendered magnetic, or by exposing it to certain rays of light, or if suspended in a particular position for some time. Iron possesses some degree of elasticity—a wire, one-tenth of an inch in thickness, supporting 400 lbs. Steel, however, its carburet, will support about twice as much. Iron is chiefly employed in these three states—first, as cast iron; secondly, as wrought iron; and, thirdly, as steel. In this latter state, it is a compound of carbon and iron.' Its uses are well known, both in war and peace. Some few persons may, perhaps, like to know how the metal is obtained from its ore:—In the great iron-works, the ore, mixed with lime, is thrown into the furnace, and coke being thrown on the top of it, a part of the bottom of the furnace is, however, first filled with fuel; this being kindled, and the blast of the great bellows being directed upon it, soon raises the whole to an intense heat; fresh fuel and ore being continually put on at the top, so that the furnace, when once lighted, is kept on for five, ten, and, sometimes, twenty years, until, in truth, the furnace requires rebuilding. The metal, as it melts, is let out by an aperture at the bottom.

The following are a few tests by which this metal may be detected:—Prussiate of potash turns any solution containing this metal, blue; ammonia, black; phosphate of ammonia, white; benzoate of ammonia, yellow; succinate of ammonia, flesh colour; but the best test is a solution of nut-galls; this will turn the solution a very deep black. This, when stiffened with gum and strained, is the common black writing-ink.

THE CHEMIST.

HEAVY CARBONATED HYDROGEN GAS.

This gas was first brought into notice by a society of Dutch chemists, consisting of Deiman, Troostwyk, Bond, and Laurenburgh. They observed in this gas the particular property, that when it was combined with oxygenated muriatic acid gas, in a certain proportion, the elastic form of both fluids became destroyed, and an oil was produced; for which reason they called it olefiant gas.

Heavy carbonated hydrogen gas is not absorbed or altered by water. Its weight, compared with common air, is as 909 to 1000. It has a disagreeable fetid odour, different from that of light carbonated hydrogen gas. It burns with a strong compact flame, similar to that of a resinous oil. When mixed with oxygenated muriatic acid gas, its bulk is diminished, and an oil is formed. When the mixture of these two gases is fired, a quantity of charcoal is immediately deposited, in the form of fine soot. Sulphuric, sulphureous, nitric, nitrous, and muriatic acids do not act upon it; neither does nitrous gas, nor any of the fixed alkalies. Ammonia adds to its volume, without occasioning any other change. Phosphorus heated in it, even to fusion, does not affect it. When made to pass through an ignited glass tube, it does not diminish in volume, but loses the property of forming oil with oxygenated muriatic acid gas. Electric shocks pass through it, dilate, and likewise deprive it of this property. When passed through an ignited porcelain tube, it affords hydrogen gas, mingled with carbonic acid, and carbon is deposited. When passed through a tube with sulphur in fusion, sulphurated hydrogen gas is obtained, and charcoal deposited. When burnt with oxygen gas, or when passed through a red-hot tube, filled with oxide of manganese, carbonic acid gas is formed.

Heavy carbonated hydrogen gas is obtained by decomposing alcohol by sulphuric acid, at high temperatures. It is also obtained in abundance, when alcohol or ether is passed through a red hot earthen tube. Sulphuric ether, mixed with sulphuric acid and subjected to heat, also affords it, but in a less pure state.

In order to obtain this gas, the following method may serve:—

Let four parts of concentrated sulphuric acid, and one of highly rectified ardent spirit, be mingled gradually in a glass retort; heat will be developed, the mixture

will become brown, and heavy carbonated hydrogen gas will be extricated, without the application of external heat. When a moderate heat is applied, the action is very violent, and the gas is liberated very copiously, and may be received over water. The gas obtained is always mixed with a considerable quantity of sulphureous acid gas, from which it may be freed, by agitating it in contact with lime-water, or a solution of potash.

In this operation, the heat ought to be regulated with great care, and the retort holding the mixture, ought to be very capacious, otherwise the matter will be forced over into the receiver. The heat of a candle or lamp is sufficient.

MISCELLANEA.

Pin-making.—A pin-making machine has been set up at Stroud, which makes pins with solid heads, from the wire to the polishing, without the interference of the hand. A water-wheel of forty-horse power, works 100 several machines, which produce 4500 lbs. of pins per week, or nineteen millions of pins.

Patents.—A patent in the United Kingdom, owing to the multiplied fees of sinecures, costs from 100*l.* to 125*l.*, and it secures for fourteen years. In France and the Netherlands, it is for three terms of five years, and costs from 12*l.* to 60*l.* in France, and 6*l.* to 30*l.* in the Netherlands. In the United States for fourteen years, and costs but 6*l.* 15*s.* Spain grants fifteen years to an inventer, ten years to an improver, and six years to an introducer. The number in England, France, and Austria, is about 160 in each per annum. —*Phillips.*

Machinery. — Marshall estimates our mechanical power of machinery at 12, and its consuming power at only 1; and hence the miseries inflicted on labourers; for the manufacturers are not a seventh of the population, and their machinery supercedes the domestic labour of half the cottage population.

Friction.— In complicated machinery, steam-engines, &c., friction is one-third or two-fifths of the force, unless diminished by gurnetts, or other friction-wheels. Friction is the parting with motion or force, to surfaces in contact with the mover; and resistance is the parting with motions to the atoms of any medium through which a body in motion is passing. Friction varies with the nature of the surfaces rubbed, and with the weight or downward force of the mover. Ferguson found that the friction of soft smooth woods was a third of the weight; rough woods, half; soft or hard, a fifth; steel on steel, a quarter; steel on brass, a sixth. Gun-metal against steel has but two-thirds the friction of cast iron against steel.

INSTITUTIONS.

LECTURES DURING THE WEEK.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street. — Thursday, March 10, Edward Cowper, Esq., on the Application of Machinery to Engraving, Carving, and Sculpture. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, March 7, Mr. Jos. Thorne's Historical Recollections. At half-past eight.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, March 8, Mr. Cooper, on Geography. At eight o'clock.

QUERIES.

How to ascertain the quantity of oxygen and hydrogen in the atmosphere? A. Y. S.

I shall feel obliged to any person who can give me a sketch, with description, of the instrument employed for setting tools used in engine and ornamental turning, so as to insure a repetition of the same angle. Also, for an account of the best guage for screws; and any information respecting the screw-stock and dies, particularly if of improved construction, will be acceptable. Can any of your correspondents refer me to a work containing a description of Asa Spencer's "Geometrical Lathe;" it was, I believe, patented in America? A. M.

"G. S., Jun.," would oblige "A. B." by letting him know the thicknesses of wood for the various organ-pipes. Also, whether the same scale will do for different kinds of pipes.

The best means of drying colours prepared with Indian rubber? J. J.

The best and cheapest manner of making test-papers, for detecting in coal gas the following:—Sulphuretted hydrogen, carbonic acid gas, ammoniacal gas, or the presence of ammonia in coal gas? T. H. N.

Where can I purchase plated silver for the Daguerreotye; I wish to have it ready polished? likewise the price thereof? G. Carrington.

Where can I obtain the instrument called a pedometer; or have any of your readers one at a small charge to sell? J. E.

The manner in which seal stones are engraved? A. B.

What are the best works on electrotype, pyrotechny, electricity, galvanism, electro-magnetism, and their respective prices? R. M. O.

A description of Grove's battery, and the best place to buy materials for the same, will greatly oblige J. Fitzpatrick.

In a late Number of your valuable little publication, "W. F." gives a description of an electrotype engraving apparatus, which I do not clearly understand. He says, "affix the medal, or other object to be copied, to the end of the copper wire, opposite the zinc; bend the wire so that the zinc may remain inside the porous cell, and the mould in the solution." Now am I to understand him to mean the medal and mould to be the same; if so, what is it that bears the impression? B. S. M.

Having solved the underneath question by a cubic equation, I should feel obliged if any of your talented correspondents could inform me, accompanied with a solution, if it could be solved by a simpler process:—The three chords of three arcs, completing a semicircle, being given 3, 4, and 5, respectively; required the diameter. Also solutions to the following questions will much oblige:—The length of the three lines drawn from the three angles of a plane triangle, to the middle of the opposite sides, being 17.56, 23.5821, and 29.756 respectively; required the sides of the triangle, without the aid of algebra.

The value of x and y $\begin{cases} x + y = a \\ x^3 + y^3 = b \end{cases}$ By a simple equation.

$$a\,x = (\sqrt{1 + x} - 1)(\sqrt{1 - x} + 1)$$

By quadratic.

I beg to inform "Mr. J. Cordey," that I have solved, by approximation, to six places of decimals, the question given by him in No. 56, Third Series—viz.

$$x\,y = 125\,x + 300\,y$$
$$y^2 - x^2 = 90000.$$

But I take it for granted, that he has a more simple method of solving the question, and should feel obliged if he would insert his solution of it.

C. Brothers.

ANSWERS TO QUERIES.

The Quantity of Carbonic Acid generated by Man, is nearly a cubic foot per hour, by which he gives off half-an-ounce of carbon; and the conversion of oxygen gives out the quantity of animal heat, in the difference of the specific heat of both.

Oxygen Gas.—A dull-red heat is quite sufficient to liberate oxygen from the black oxide of manganese, or from the red oxide of lead. Oxygen gas may also be obtained from the nitrate or oxymuriate of potash, heated strongly in a glass or porcelain retort. R. M. O.

"D. G." There is no profitable method of adulterating sulphate of copper. If he will consult the Penny Mechanic for the last few months, he will find ample directions in the answers to correspondents. There are various kinds of electro-magnetic apparatus for various and very different purposes. If he will state his purpose, I will endeavour to assist him.

"B. Trole." The method of polishing steel depends on the kind of article. W. H.

Preparation of Gold Powder for Gilding.—Gold powder may be prepared different ways—viz. put in an earthen mortar some gold leaf with a little honey or thick gum-water, and grind the mixture till the gold is reduced to extremely minute particles; when this is done, a little warm water will wash out the honey or gum, leaving the gold in a pulverulent state.

Another Method.—Dissolve pure gold (or the leaf) in nitro-muriatic acid, and then precipitate it by a piece of copper, or by a solution of sulphate of iron. The precipitate, if by copper, must be digested in distilled vinegar, and then washed by pouring water over it repeatedly, and dried; this precipitate will be in the form of a very fine powder; it works better, and is more easily burnished than gold leaf ground with honey as above.

TO CORRESPONDENTS.

G. Carrington.—*His communication did not reach us, or it would have been replied to in due course.*

W. H., Long Sutton.—*There is no means of producing the liq. ammonia, except by distillation. In manufacturing large quantities, a greater heat is applied, by which it comes off quicker. A gallon of water ought to produce at least twenty-four ounces. The same with spirits of nitre: three pints of spirits of wine, and 12 oz. (by weight) of nitrous acid, should produce 2½ pints.*

By a work on manufacturing chemistry, we suppose he means one describing the different processes employed by manufacturing chemists. No work of this kind is published, as every wholesale chemist has his peculiar formula for each article. The only real standard work is the London Pharmacopœia.

W. Hopkinson.—*Any communications he may forward us, will be received with thanks, and have our attention.*

If the price is given with description of electrical machine, it will constitute an advertisement. The duty (1s. 6d.), he can send us in postage stamps; or, if he wishes, we will insert it without price.

J. M. M.—To Brown Gun-barrels.—*Take 1 drachm of corrosive sublimate (poison); ½ oz. of tincture of steel; ½ oz. of sweet nitre; 10 drops of nitrous acid; ½ pint distilled water. Dissolve. Let the barrel be rubbed bright, and free from grease; then apply a coat of the above with a piece of flannel rag, and let the barrel stand in a warm place six hours; then rub off with a fine steel scratch-brush; continue six or seven times; then pour over the barrel a kettle of boiling water, and finish off with a little fine olive oil. Another method will be found in vol. 4 of the* Penny Mechanic, *No 3, p. 23, to which we would refer him for information on the subject.*

W. Y.—*The same answer as is given to "J. M. M," will apply also to him.*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.

No. **71**, THIRD SERIES. | SATURDAY, MARCH 12, 1842. | No. 319, OLD SERIES.

FORMATION OF TEETH OF WHEELS.

Fig. 1.

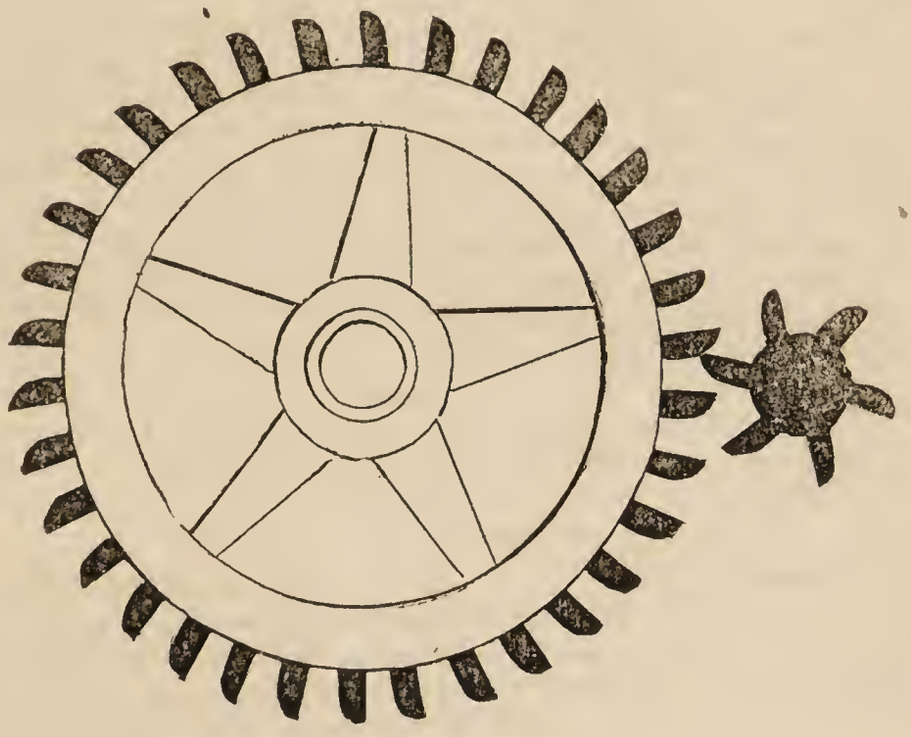
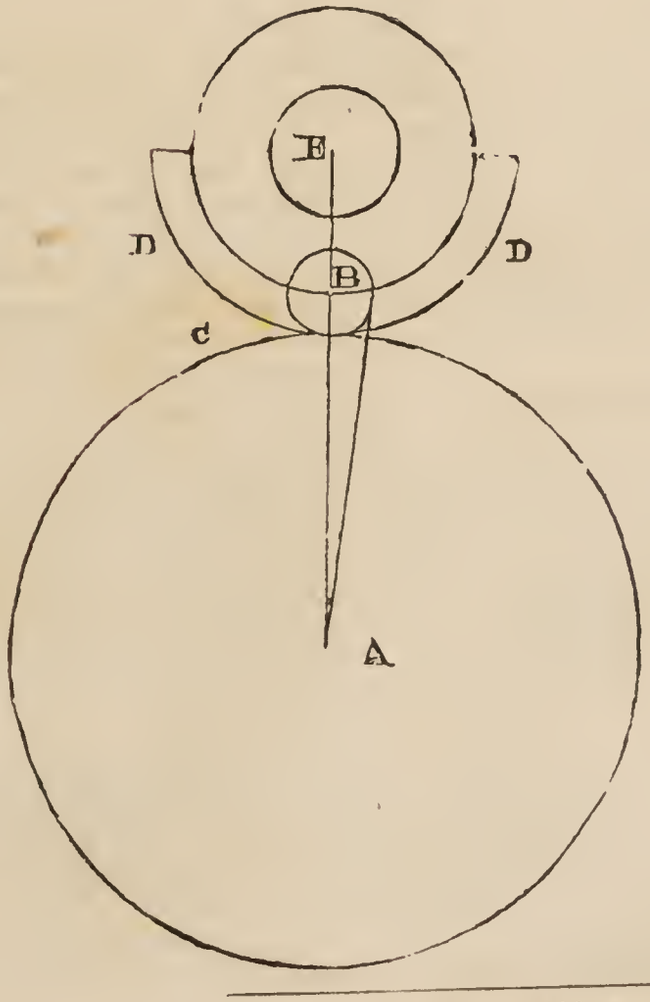


Fig. 2.



Vol. VIII.—No. 12.] [City Press, 1, Long Lane, Aldersgate Street: D A. Doudney.

ON THE FORMATION OF THE TEETH OF WHEELS.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—As the formation of the teeth of wheels is of much importance to every machine, and ought to engross the attention of every mechanic that is concerned in the construction of machinery, &c., where they may be employed; I have taken the liberty of addressing you upon that subject, and to offer a plan for the construction of teeth, where power will be gained, by the diminution of friction.

It is well known, that a wheel and pinion will have the same force moving each other, when the axes of both are parallel; or, in other words, when a line is drawn from the point of contact of the teeth, perpendicular to their respective curves, so as to pass through the point where the primitive circumferences meet; and that property is possessed by the epicycloidial teeth; the form of the tooth I am about to explain, being an half epicycloid.

Description of the Engravings.

Fig. 1 represents a wheel and pinion, with the anti-friction teeth.

Fig. 2 is a sectional view of the form of tooth; A is the wheel; B, the cycloid, from which the form of the tooth is taken; C, primitive circle of the wheel; D, primitive circle of the pinion; E, the pinion.

The superiority of these teeth over others, arises from there being a less surface exposed to friction; the point of the tooth coming in contact with the back of the pinion tooth, and *vice versâ* when the pinion is used as the driving power.

T. R. Bilbrough.

DESCRIPTIVE GEOLOGY.

(Continued from p. 70.)

OLDER PLIOCENE PERIOD.

Character of Formations.	Examples of Localities.
Marine	Northern subapennine formations, as at Parma, Asti, Sienna, Perpignan, Nice—English crag.*
Fresh-water	Alternating with marine beds, near the town of Sienna.
Volcanic	Volcanoes of Tuscany and Campagna di Roma.

Lyell, vol. 3, page 381.

Organic Remains.—The deposits of the older pliocene period abound in extinct *species* of existing *genera* of pachydermata—that is, elephant, rhinoceros, hippopotamus, and horse; together with the extinct genus mastodon. The number of ruminantia and rodentia becomes enlarged; and the carnivora assume a numerical importance commensurate with the increased numbers of terrestrial herbivora.

CRAG FORMATION.

Mineral Character.—It resembles almost exactly a shingle or pebble-beach, with layers of sand and shells; being composed of pebbles of various sorts, rolled and worn fish-teeth and bones, a few bones of extinct large quadrupeds, also worn; many shells, sometimes worn, sometimes not; parts of crustacea, polypifers, &c. The whole has an ochreous aspect, from the admixture of oxide of iron. The above is the character of the upper part of the formation (red crag). The lower part is lighter in colour and more uniform in composition, and appears to have been deposited with more tranquillity. It is a coralline limestone at Orford, and contains abundance of shells, *not at all worn*, and not ochreous, at Ramsholt and other places (coralline crag).

The crag deposit is found in low ground, along the east coast of England; resting, in a few places, upon the London clay. It may be, perhaps, rightly viewed as a part of the ancient bed of the German Ocean, the upper part having been accumulated under the influence of littoral currents.

NEWER PLIOCENE PERIOD.

Character of Formations.	Examples of Localities.
Marine	Strata of the Val di Noto, in Sicily, Ischia.
Fresh-water	Valley of the Elsa, around Colle, in Tuscany.
Volcanic	Older parts of Vesuvius, Etna, and Ischia—volcanic rocks of the Val di Noto, in Sicily.

* Crag is a Suffolk word, and signifies gravel

To this period belong many accumulations of loose gravel, which cover vast globe, tracts of country in most parts of the and which are called, by some geologists (Smith and Buckland), diluvial gravel and diluvium. This term was adopted to express the inference, that the deposition of the gravel was "due to an extensive deluge,* or succession of analogous deluges, sweeping over the dry land after the completion of the stratified rocks; and it was the more readily received, because it seemed to offer a satisfactory coincidence with the Noachian or historical deluge." —*Phillip's Guide to Geology*, page 98.

In connexion with the transportation of gravel, must be mentioned those immense blocks of stone, which often exist in situations far remote from the places whence they are supposed to be derived. They are usually known by the term *erratic blocks*.

The size of these blocks varies from 10,000 cubic feet to a few inches. There is one, for instance, on the Vigneule, near Bienne, which is twelve feet high, thirty feet long, in one direction, twenty-four in another, and eighteen in a third. Another, known by the name of Pierre à Martin, on the hill of Boisi, is twenty-two feet high, eighteen feet wide, and twenty-six feet long.

Their nature is not less various than their size. Every species of rock seems to have contributed a portion of its substance towards the mass, though the harder, being better capable of resisting the action of atmospheric causes, are found in the greatest abundance.

The distribution and situation of these blocks are also very different. Seldom isolated, they are generally found in patches or groups, as upon the shores and the hills round the Leman lake, the plains of Westphalia, &c.; or in long bands, as in the north of Mecklenberg Strelitz; or widely spread over considerable tracts, as between Warsaw and Grodno, between St. Petersburgh and Moscow, &c. Sometimes they cover horizontal plains, as in the north of Germany; sometimes they rest on the sloping sides of mountains, as in the Alps and Jura; and, occasionally, on the very top of lofty eminences. Sometimes they are seen in great abundance at the bottom of valleys, where they open into the plains, and, in other instances, they are found collected in great numbers in the high and narrow parts of the valleys.

(To be continued.)

* *Diluvium* being Latin for deluge.

MAGNETIC POLARITY.

Although the bar-magnet, or compass needle, uniformly preserves its compass-directing power in both hemispheres of the earth, it is, nevertheless, imagined by Lieutenant James Sabben, R.N., that the character and intensities of its respective poles vary, and are affected, in these widely-separated situations, to the amount of the following representation — namely, that, in high southern latitude, the south pole of a freely traversing bar-magnet would be found possessed of all the characteristic forces, powers, and peculiarities, which belong to, and manifest themselves in, the north pole of a similar magnet, and, when similarly circumstanced, in high northern latitude; and *vice versâ*. He farther imagines, that the truth of this position, of any transfer of properties from one pole of the bar-magnet to its other, as is supposed by him to take place, might be correctly ascertained, by resorting to the use of sets of electro-galvanic experiments made on it (the results of which alter not, either in their character, or the nature of the polarity, wheresoever performed), and when conducted as far north and south from the equator as possible. In these distinct instances, it is his belief that, in the southern hemisphere of the globe, the south pole of the compass needle would be discovered to respond to those electro galvanic tests of its properties, in the same order, and precisely in the same manner, as its north pole is known to do to them in the northern hemisphere: occurrences which, if once proved, would present the event in the light of a discovery of an important scientific fact. Aware, however, that it does not fall but within the range of few to put in practice the above-named truly testing experiments, he feels it his duty to state, that he considers a horse-shoe magnet, when properly used, might be rendered an excellent substitute for them: for he conceives, by reason of its peculiar construction, and by keeping its arming unremoved, while it is undergoing conveyance from high north to high south latitude, or contarriwise, that its induced polarity, and all its characteristics, will be permanently preserved, notwithstanding such change of place, and remain altogether exempt from those alterating influences which, it is thought, do affect the poles of the bar-magnet, when subject to similar removal. Regarding it in this available light, in order, then, to make it efficient in the hands of any one about to leave England for the southern hemisphere, the

following detailed arrangement and process forms all that is requisite to be attended to:—That, before sailing, the respective poles of the instrument be most carefully labelled, to prevent all mistake about them, which, of course, would be fatal to the result; and that its arming be kept constantly on during that portion of the voyage, until the utmost southing shall be reached. When arrived there, the arming, for the first time, is then to be removed from the horse-shoe magnet, whose poles, so liberated, are immediately afterwards, to be distinctly and changingly applied to those of a bar-magnet or compass-needle, whose freedom in traversing has undergone no interruption during the passage. And now for the issue! If, while making these experiments, it should be found that the poles of the last-named magnet are affected by, and respond to, the applied poles of the first-named magnet, in precisely the same order as they are observed and known to do in high northern latitude, then the opinion, previously advanced, falls to the ground as worthless; whereas, should the reverse of all this ensue, should it become obvious, as Lieut. S. suspects it would, that the labelled north pole of the horse-shoe magnet attracts the north pole of the bar-magnet, and all the other phenomena of repulsion and attraction observe a corresponding order, then it will be manifest, that the stores of science are become enriched, that an important and ever-enduring philosophical truth has been discovered. And here it may be emphatically asked, "Shall the possibility of achieving it be left to foreigners, or shall that honour be won by Englishmen?"

CHARACTER OF ENGLISH AND FOREIGN ARTISANS.

No. III.

From the examination of Mr. James Kempson, a cotton-manufacturer of Philadelphia, we discover that the American workmen are, almost invariably, better educated, and more intelligent, and more moral, and refrain more from sensual indulgence* than the English. The latter soon become discontented, and they show their ill-will and hostility towards the masters, by strikes and demands for wages —almost always ill-considered — with which the masters cannot comply, and which grievously interfere with their commercial operations.

Mr. William Fairburn, an engineer, employing about 680 workmen in Manchester, and between 400 and 500 in London, was next examined. His statements go to show, that the mechanics who come from Scotland and the north of England, Cumberland and Northumberland, have generally received a tolerably good education. They read and write; they are often good arithmeticians, and, in some instances, they have a knowledge of the lower branches of mathematics; some of them draw very well. The Irish mechanics that Mr. F. employs, are chiefly from the north of Ireland, and, in point of school education, rank nearly with the mechanics from the north of Britain, though they are somewhat lower in technical training as mechanics. The mechanics from Yorkshire, Lincolnshire, and the south of England, are below those of the northern counties, though they are very good mechanics.

Mr. Fairburn says, "It is always an indication of looseness of character, and a low standard of moral conduct, to see a mechanic in dirt, or in his working clothes, on Sunday. Thirty years' experience leads me to draw a very unfavourable conclusion as to the future usefulness to me, and of success to himself, of any workman whom I see in dirt on a Sunday."

The best-educated workmen are invariably intrusted with the most important parts of work. If there be any intricate work, or anything that requires close mental application, as a class, the men of the best school education are always selected. In out-door work, when, for example, there is a steam-engine, or a water-wheel, or mill-work to erect, a foreman, or some responsible workman, must be chosen; and the choice, in nine cases out of ten, falls on the man of the best school education. In all questions respecting wages, the best-educated workmen are always found to be the most reasonable in their demands, and the most peaceable in their behaviour, most readily assenting to proper changes, whether for or against themselves.

It was, formerly, a prevalent opinion among employers of labour, that strong drink was necessary as a stimulus for the performance of labour; but it is now very generally abandoned: there are, nevertheless, some foundries in which there is drinking throughout the works all day long. It is observable, however, of the

* Whiskey is there but ninepence per gallon, wholesale price, and the English are not able to resist the temptation.

men employed as workmen, that they do not work so well; their perceptions are clouded, and they are stupified and heavy. In general, the men who drink water are really more active, and do more work, and are more healthy, than the workmen who drink fermented liquors. The boatmen, or rowers to the caiques at Constantinople, who are, perhaps, the first rowers in the world, drink nothing but water; and they drink that profusely during the hot months of the summer; yet these men, are, perhaps, the finest in Europe, as regards their physical development.

THE CHEMIST.

EUDIOMETRY.

The eudiometer is an instrument by which the quantity of oxygen and nitrogen in atmospherical air can be ascertained. Eudiometers are all founded on the principle of decomposing common air by means of a body which has a greater affinity with the oxygen.

No sooner was the composition of the atmosphere known, than it became an inquiry of importance to find out a method of ascertaining, with facility and precision, the relative quantity of oxygen gas contained in a given bulk of atmospheric air.

The instruments in which the oxygen gas of a determined quantity of air was ascertained, received the name of eudiometers, because they were considered as measurers of the purity of air. They are, however, more properly called *oximeters*.

The eudiometers proposed by different chemists, are the following:—

1. *Priestley's Eudiometer.*

The first eudiometer was made in consequence of Dr. Priestley's discovery, that when nitrous gas is mixed with atmospheric air over water, the bulk of the mixture diminishes rapidly, in consequence of the combination of the gas with the oxygen of the air, and the absorption of the nitric acid thus formed by the water.

When nitrous gas is mixed with nitrogen gas, no diminution takes place; but when it is mixed with oxygen gas in proper proportions, the absorption is complete. Hence it is evident, that in all cases of a mixture of these two gases, the diminution will be proportional to the quantity of the oxygen. Of course it will indicate the proportion of oxygen in air; and, by mixing it with different portions of air, it will indicate the different quantities of oxygen which they contain, provided the component parts of air be susceptible of variation.

Dr. Priestley's method was, to mix together equal bulks of air and nitrous gas in a low jar, and then transfer the mixture into a narrow graduated glass tube, about three feet long, in order to measure the diminution of bulk. He expressed this diminution by the number of hundredth parts remaining. Thus, suppose he had mixed together equal parts of nitrous gas and air, and that the sum-total was 200 (or 2.00); suppose the residuum, when measured in the graduated tube, to amount to 104 (or 1.04), and, of course, that ninety-six parts of the whole had disappeared, he denoted the purity of the air, thus tried, by 104.

This method of analyzing air by means of nitrous gas, is liable to many errors. For the water over which the experiment is made, may contain more or less carbonic acid, atmospheric air, or other heterogeneous substance. The nitrous gas is not always of the same composition, and is partly absorbed by the nitrous acid which is formed; the figure of the vessel, and many other circumstances, are capable of occasioning considerable differences in the results.

Many eminent philosophers have made series of laborious experiments, to bring the test of nitrous gas to a state of complete accuracy; but, notwithstanding their exertions, the methods of analyzing air by means of nitrous gas, are liable to so many anomalies, that it is unnecessary to give a particular description of the different instruments invented by them.

2. *Scheele's Eudiometer.*

This is merely a graduated glass cylinder, containing a given quantity of air, exposed to a mixture of iron filings and sulphur, formed into a paste with water. The substances may be made use of in the following manner:—

Make a quantity of sulphur in powder, and iron filings, into a paste with water, and place the mixture in a saucer or plate, over water, on a stand raised above the fluid; then invert over it a graduated bell-glass, and allow this to stand for a day or two. The air contained in the bell-glass will gradually diminish, as will appear from the ascent of the water.

When no farther diminution takes place, the vessel containing the sulphuret must be removed, and the remaining air will be found to be nitrogen gas, which was contained in that quantity of atmospheric air.

In this process, the moistened sulphuret of iron has a great affinity to oxygen; it

attracts and separates it from the atmospheric air, and the nitrogen gas is left behind; the sulphur, during the experiment, is converted into sulphuric acid, which unites to the alkali, and forms sulphate of potash.

The air which is exposed to moistened iron and sulphur, gradually becomes diminished, on account of its oxygen combining with a portion of the sulphur, which becomes converted into sulphuric acid, and its nitrogen remains behind. The quantity of oxygen contained in the air examined, becomes thus obvious, by the diminution of bulk, which the volume of air, submitted to examination, has undergone.

The only error to which this method is liable is, that the sulphuric acid which is formed, acts on the iron and produces hydrogen gas, which joins to the nitrogen remaining after the absorption, and occasions an incorrect result; and hence it is, that the absorption amounts in general to 0.27 parts, although the true quantity of oxygen is no more than from 0.21 to 0.22.

3. *De Marti's Eudiometer.*

De Marti obviated the errors to which the method of Scheele was liable. He availed himself, for that purpose, of a hydrogenated sulphuret, formed by boiling sulphur and liquid potash or lime-water, together. These substances, when newly prepared, have the property of absorbing a minute portion of nitrogen gas; but they lose this property when saturated with that gas, which is easily effected, by agitating them for a few minutes in contact with a small portion of atmospheric air.

The apparatus is merely a glass tube, ten inches long, and rather less than half-an-inch in diameter, open at one end, and hermetically sealed at the other. The close end is divided into 100 equal parts, having an interval of one line between each division. The use of this tube is, to measure the portion of air to be employed in the experiment. The tube is filled with water; and, by allowing the water to run out gradually, while the tube is inverted, and the open end kept shut with the finger, the graduated part is exactly filled with air. These hundred parts of air are introduced into a glass bottle, filled with liquid sulphuret of lime, previously saturated with nitrogen gas, and capable of holding from two to four times the bulk of the air introduced. The bottle is then to be closed with a ground-glass stopper, and agitated for five minutes. After this, the stopper is to be withdrawn, while the mouth of the phial is under water; and, for the greater accuracy, it may be closed and agitated again. Lastly, the air is to be again transferred to the graduated glass tube, in order to ascertain the diminution of its bulk.

4. *Humboldt's Eudiometer*

Consists in decomposing a definite quantity of atmospheric air, by means of the combustion of phosphorus, after which, the portion of gas which remains must be measured.

Take a glass cylinder, closed at the top, and whose capacity must be measured into sufficiently small portions, by a graduated scale fixed on it. If the instrument be destined solely for examining atmospheric air, it will be sufficient to apply the scale from the orifice of the cylinder down to about half its length, or to sketch that scale on a slip of paper pasted on the outside of the tube, and to varnish it over with a transparent varnish.

This half of the eudiometrical tube is divided into fifty equidistant parts, which, in this case, indicate hundredth parts of the whole capacity of the instrument.

Into this vessel, full of atmospheric air, put a piece of dry phosphorus (one grain to every twelve cubic inches), close it air-tight, and heat it gradually, first the sides near the bottom, and, afterwards, the bottom itself. The phosphorus will take fire and burn rapidly. After everything is cold, invert the mouth of the eudiometer tube into a basin of water or mercury, and withdraw the cork. The water will ascend in proportion to the loss of oxygen gas the air has sustained; and thus its quantity may be ascertained.

(To be cont'n ed.)

HOLLOW FLAME.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I observed a communication in your last week's Number, headed "A Hollow Flame," signed "J. Fuller, Jun." He says, "I believe it is not generally known, that the flame of spirits of wine is hollow," and gives an experiment to prove that it is so. Dr. Murray gives almost the same experiment in his "Manual of Chemical Experiments," to prove, *not* that the flame of spirits of wine *alone* is hollow, but that *flame* is hollow. As I entirely disagree, both with the very learned authority I have just quoted and your correspondent, perhaps you will be kind enough to allow me to explain my views on the subject, which, whether they be well founded or

original, you will be best able to judge. The present theory of flame is, that it is produced by the chemical action of combustible matter, or a supporter of combustion. If this theory be correct, it will follow, that where there is the combustible body without the other, there will be no flame, and *vice versâ*. That this is the case, has been often proved; and the question of a flame being hollow, is entirely a matter of circumstance. A hollow flame can be made by the means shown by your correspondent, for this reason — that the combustible vapour, which is a mixture of carbon and hydrogen, arising from its surface only, comes in contact with the atmospheric air; the oxygen of which is the supporter at its outside. That, therefore, being the only place where the two can unite chemically, the flame is a thin sheet. The same may be said of the flames of gas, common coal, oil-burners, &c. The production of a flame to pervade the whole of the space it encompasses, can easily be made, by a mixture of common coal gas and air in oxygen, called an explosive mixture. In this case, each atom of gas, combustible, and supporter, lay along side, or incorporated in each other, in order the instant ignition is communicated to form one mass of flame by their chemical action upon each other. This, I think, is a logical deduction from the present theory. Gunpowder, and all other explosive matters which possess their combustible and supporting matter in proper quantity, I imagine, follow the same rule.

I remain yours, &c.,

A. W.

THE NEW PATENT MANURE DISCOVERED BY MR. DANIELL.

The discovery of Mr. Daniell was suggested by the fact that, while burning vegetables, he observed that the ashes became blackened by the surrounding smoke, and, when used in that state, were very fertilizing. This led him to inquire and investigate the cause, and, as the result of his investigation, he had produced the new manure, the elements of which were carbon and ammonia. With it the principal properties would not fly off during decomposition, as that would take place in the earth. Among other advantages, it was light in weight, cheap, and capable of being produced in any quantity. This manure has been applied by the discoverer to his own crops, on three acres of poor land, in an elevated situation; on some of which he has grown wheat four successive years, with improving results each year; its good effects are, therefore, founded upon experience, personal observation, and the testimony of other observers competent to judge. Individuals of scientific attainments, to whom it has been communicated, are satisfied that the elements of which it is composed, are all distinctly beneficial as contributing to vegetation—some rapidly so, others gradually, and some for a considerable period. From the nature of the manure, it is applicable, with some variation in its composition, to every kind of crop. It is not a stimulating manure, in the ordinary sense of the word—that is, it will not have a tendency to call into activity the existing resources in the soil—but its direct effect is to convey to the soil the direct nutriment of future growth. This effect is produced by the supply of ammonia to the soil, in substances calculated to retain it for a time—to again absorb from the atmosphere—as they give it out to plants during their growth. It is, therefore, evident, that there is nothing in the disposition of the manure to lead to future sterility, but everything the reverse. It will, probably, prevent the ravages of insects. Its mode of application may be various, according to the differing circumstances of the crops. The application by drill is conducive to economy of the manure, and a direct application to the infant plant, as is the case with bone dust. Care, however, must be taken, that it is not applied too directly to the plant, or without some portion of mould around it. This is the only precaution needed to avoid danger in its use. There is one required to prevent waste, as it is of a volatile character—that is, to place it several inches in the earth, as the earth will absorb and retain the volatile and valuable part. For grass lands, for similar reasons, it will be well to have it mixed with a considerable portion of ordinary unvalued mould. If the manure, as manufactured, be mixed with an equal bulk of mould, it will be perfectly safe for application; or if the mould of the field be stirred among it when drilled, it will suffice. The quantity to be applied will vary according to the crop, like any other manure. About twenty-four bushels per acre are recommended for wheat, and half as much more, or thirty-six bushels, might be beneficially applied for turnips or mangel wurzel. The most beneficial quantities will be easily ascertained by the intelligent farmer. The manure is a coarse black powder, having a strong smell, somewhat resembling coal tar. The crops produced by it are greater in quan-

tity, better in quality and weight, and produced with one-third the ordinary quantity of seed. The manure will, probably, be about one-third the present price of bone-dust.

MISCELLANEA.

The Rosherville Pier and Garden Company.—We are happy to find, that this very desirable undertaking is increasing in importance and utility, and that the Company are already adopting such measures as shall secure to the public, by means of shares of 5*l.* each, a permanent and a widely-extended interest in the same. The Blackwall Railway being now opened from the centre of the City, the passage to Rosherville can be accomplished in little more than an hour, at a very low rate of fare. Thus a short hour (embracing a variety of pleasing scenery) and a low charge, will, in the approaching season, place this delightful excursion within the reach of almost every artizan in the Metropolis; and will secure to the shareholders one of the most lucrative and best speculations of the day. We shall, on a very early occasion, furnish our readers with an accurate description of the gardens, and show the advantages they possess over every other enterprise of a similar description.

The Piston of a Steam-engine works twice the length of the cylinder at each stroke; and at a maximum, in a nine-feet stroke, fourteen per minute; travels 250 feet, or, with a six-feet stroke, at twenty-one per minute, 210 feet. The effective force of a piston is taken at 10 lbs. per square inch, or two-thirds of the atmospheric pressure, and is, of course, ten times the square inches in pounds. This force, by the number of feet the piston moves per minute, is the momentum, or lifting-power per minute. The momentum, or lifting-power, per minute, divided by 33,000, a one horse power, is the number of horses equal to the engine.

INSTITUTIONS.

LECTURES DURING THE WEEK.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, March 17, Edward Cowper, Esq., on the Application of Machinery to Engraving, Carving, and Sculpture. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, March 14, T. Smith, Esq., on the Evils of the present state of Society, and the Efficiency of the various Remedies proposed—Emigration, Free Trade, Chartism, Socialism, and Poor Laws. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, February 17, J. S. Buckingham, Esq., on Syria. At eight o'clock.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, March 15, Mr. J. S. Benstead, on the Hindrances and Obstructions to the Development of the Human Intellect by Strong Drink. At eight o'clock.

QUERIES.

The best method of making family vinegar? Also, how to remove stains from the leaves of a book? G. F. B.

Is there any method of taking grease out of card-board? J. Davies.

How to cement the inside of a box, so as to hold the solution for electrotyping? Also, which is the best battery to produce a copper-plate in the shortest time? A. C. R.

What is the composition used for filling engravings on ivory or bone, such as we see on handles of knives, &c.? Also, how are the steel plates used for etching, softened, and, after the etching process, again hardened? Utile.

Will a green glass wine-bottle do for the cylinder of an electrical machine; if so, how can I cut the neck of the bottle off? 2. Has any of your correspondents a cheap second-hand electrical machine to sell; if so, the probable price; or is there any one that can practically show me how to make one? 3. Which is the best way of taking an impression from a print or engraving, without spoiling or injuring the same? I have tried to take one with a ley of soap and alum, but it only yields a very imperfect impression? 4. The best way of cleaning iron chains to look like new? 5. I have made an electrophorus after the following description:—The bottom part is made of a piece of tin, with the edges turned up, to hold the following composition—equal parts of pitch, tar, resin, and bees' wax; the upper part is made of a piece of wood, covered with tinfoil, with a glass handle. I have adopted the usual method to get the electric spark, by warming the apparatus, rubbing the resinous plate, &c., but have failed. 6. Whether an air-pump can be made from a common squirt; if so, how? W. Courtney.

TO CORRESPONDENTS.

T. Kemble.—*We are obliged by his hints; but he must bear in mind, that our Magazine is intended occasionally to contain amusement, as well as instruction, for our readers; and especially such amusement as is contained in the pieces he complains of, which are not only entertaining, but instructive.*

Answers to various correspondents in our next.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

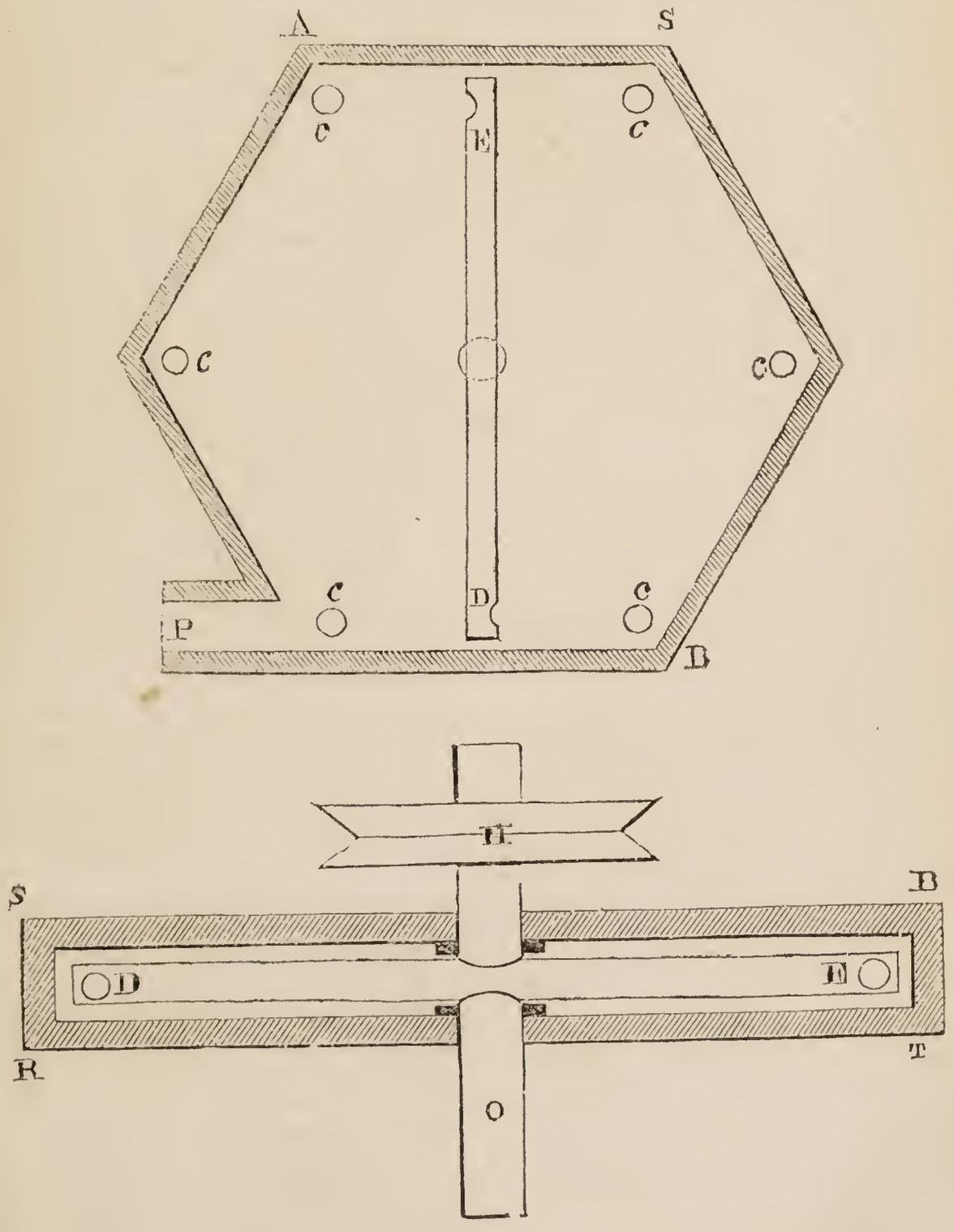
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 72, THIRD SERIES. | SATURDAY, MARCH 19, 1842. | No. 320, OLD SERIES.

ROTARY ENGINE.



Vol. VIII.—No. 13.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ROTARY ENGINE.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—I send the following drawing and description of a rotary engine, if you think it worth inserting in your Magazine. A beam-engine, with the same quantity of steam, will perform a much greater quantity of work.

I remain yours, &c.,

W. W.

Description of the Engraving.

A B, a case of cast iron; R T, a cast-iron plate, bolted on the front of the case; C C, &c., bolt holes; D E, a small tube with three holes bored in it, one at each end, opposite to one another, from which the steam issues, and one in the middle, by which the steam enters; O is a tube, through which the tube, D E, passes. The steam enters at O, and rushes out at each end of the small tube, causing it to revolve with the rigger, H, to drive the work. The ends of the small tube, of course, are stopped up; P is the opening through which the steam escapes.

MANUFACTURE OF PINS.

It is stated that no less than twenty individuals are employed in the manufacture of pins, without including the processes which occur previously to the drawing of the brass wire. The manufacture of wire, by drawing it through a steel plate, fixed perpendicularly on a table, is supposed to have originated at Nuremberg, about the fourteenth century; but the present method of drawing through a steel plate, by the addition of revolving cylinders, urged by horses, steam, or water, is of comparatively recent invention. This draw-plate is pierced with a number of conical holes of different sizes; the size of the smaller orifice determining the diameter of the wire, which is seized by a strong pair of nippers, and forcibly drawn through these holes, when the plate is placed on the draw-frame.

As the pin-maker requires a very small shaft for his pins, the wire is made to pass through the smallest holes in the draw-plate; it then requires to be made straight, and the business of the pin-maker commences by cutting it into lengths sufficient to make six pins.

The boy who points the pins, takes about a dozen of the lengths of wire in his hand at once, and the spectator is astonished by the dexterity with which he contrives to keep them all revolving on their longitudinal axes, while he applies their extremities, first to a coarse grinding stone, and then to a finer one, revolving near the other on the same axis, to give them the necessary polish. The revolution of the wires is necessary to prevent the ends from being ground flat; and so rapidly is the operation performed, that a boy will point 16,000 pins in an hour. As soon as the two ends of the wire are pointed, a pin is cut from each extremity, and the pointing is repeated, till six pins are cut from each wire.

The process of making the heads of pins, or, as it is termed, head-spinning, consists in causing a fine wire to revolve, with great rapidity, round a straight piece of wire of proper diameter, which is afterwards drawn out, leaving the spiral coil in the form of a hollow tube, which is then cut into pieces; every two rounds of the wire making one pin's head. The heads are then put into an iron pan and made red-hot, to soften them; after which they are ready for use; and the next important point is to fix them properly on the shafts.

In the year 1543, it was enacted by statute, 34 and 35 of Henry VIII., cap. 6, "That no person shall put to sale any pins, but only such as shall be double-headed, and have the heads *soldered* fast to the shanks of the pins, well smoothed, the shanks well shapen, the points well and round filed, canted, and sharpened."

But, in our times, no man could get a living at pin-making, if he had to *solder* the heads on, or fix them by rivetting. All that is now required, is for a boy to thrust the shaft of a pin among the heads, and, catching one of them on its extremity, he fixes it firmly by striking it with a hammer on an anvil, with a small hole in it. This is done with surprising rapidity; and the principal cause of the firm adhesion which takes place between the head and the shaft, appears to be the attraction of cohesion, allowed to operate by the closeness of contact.

When the pins are thus completely formed, they are whitened, by placing them in a vessel containing a solution of grain tin in tartaric acid, or the lees of wine. In this process we have the advantage of brilliancy of surface over the continental pin-makers, who use lead and mercury instead of tin; and it is said, likewise, that on this account a puncture from a British pin is of much less consequence, than when made with a foreign one.

The pins, when thus whitened, have till a dull appearance, which is removed by agitating them in a tub containing bran; and the pins, being thus polished by friction, the bran is detached by winnowing, exactly as chaff is separated from grain. The pins are then ready for the final process of papering, an operation not easily understood, as to the mode of folding the paper, and the rapid introduction of the pins, without seeing it actually performed.

After paying all the expenses of wire, labour, &c., incurred in the process just described, the whole sum charged by the wholesale dealers, for a paper containing 100 common pins, amounts to no more than *twopence farthing*. They are, therefore, sold, in the first instance, at the rate of *forty-four for one farthing*, producing, consequently, somewhat less to the manufacturer.

There are, however, various specimens of patent pins, the perfection of the heads of which, enables the manufacturer to obtain a better price; for the great difficulty in pin-making is, to fix the head firmly, and, with regard to what may be called the machine-made pins, without leaving it in a ragged state.

An article, somewhat resembling, in its origin, a pin's head, and, perhaps, suggested, in the first instance, by bits of the spiral coil before described, is a simple ornament, called the spangle. The plan of making this little embellishment of dress, was long confined to the individual by whom it was invented, and who made a large fortune by the contrivance. It would naturally be imagined, that the spangles were cut out of a thin plate of metal, by means of a hollow punch; but, in reality, they are formed of a circular portion, or single ring of wire, which, being laid upon an anvil, and struck with considerable force, is extended in all directions equally, and converted into a flat ring, with a small hole in the centre, or into a spangle; at the same time, that an almost perfect junction of the two extremities of the ring of wire, is effected by the cohesive attraction there brought into action, as was described to occur in fixing the head of a pin.

USES OF IVORY.

Ivory is generally used for articles where wood would be easily destroyed, and where metal could not be conveniently used. It is in the hands of the turner that it is generally brought into useful shape; but extraordinary instances of carving in ivory are sometimes brought from abroad. A series of hollow spheres, sometimes amounting to twelve or even fifteen in number, are cut out of one block of ivory, one within another, from the outside to the centre. These are cut by introducing tools through lace-pattern holes, cut in the exterior.

Ivory possesses an elasticity and smoothness, which render it valuable as a material for billiard and bagatelle balls. It is sometimes carved into the form of baskets, and is used extensively as an inlaying or a veneer for various articles of fancy furniture. It is used for the scales of various kinds of mathematical instruments, as the indications can be very easily read on its surface. Other purposes to which it is applied are—artificial teeth, tablets for miniature paintings, combs, fancy toothbrushes, pianoforte keys, and sometimes as a material for flutes; although it has been observed, that the tone of ivory flutes is not so fine as those made of wood.

The mode of working up ivory into these various objects, is by means of saws, files, and different kinds of edge-tools. The saws are very thin, and frequently wetted during the process of sawing; oil is sometimes used for this purpose, but it is apt to impart a yellow colour to it. In some delicate operations, the ivory is held under water while being sawed. The process of polishing is generally with pumice and tripoli powder; or it can be polished with chalk and water, applied with a piece of leather, and afterwards rubbed hard with a piece of dry leather. The better the quality of the ivory, the better the polish it will receive.

Dr. Ure gives the following directions for etching on ivory:—A ground for etching is procured, by applying the following to the polished surface:—Take of pure white wax and clear mastich tears, reduced to a fine powder, each 1 oz.; asphaltum, in powder, ½ oz. Melt the wax over a slow fire; then first let the mastich be slowly strewed in, and dissolved by stirring, and then the asphaltum in like manner. This compound is to be poured into lukewarm water, well kneaded by the hand, as it cools, into rolls or balls of about an inch in diameter, and then kept wrapped up in taffety. White resin will answer the same purpose as mastich, and be much cheaper. The proportions should be, 2 oz. of asphaltum, 1 oz. of white resin, and ½ oz. of white wax. The ground being applied to the ivory, the figured design is to be traced through it in the usual way; a ledge of wax is to be applied, and the surface is then to be covered with sul-

phuric acid. The effect comes out better with the assistance of a little heat, and by replacing the acid, as it becomes dilute by absorption of moisture with concentrated acid. Nitrate of silver affords the best means of tracing permanent black lines on ivory.

Ivory may be stained of various colours for ornamental purposes. A green dye may be given by steeping it in nitric acid, tinged with copper or verdigris; and by dissolving in nitric acid a fourth part of its weight of sal ammoniac, ivory may be stained a fine purple colour. It may be stained yellow, by boiling it in a solution of one pound of alum in two quarts of water; and then, having prepared a decoction of turmeric, by boiling half-a-pound in a gallon of water, put the ivory into it, and let it remain half-an-hour. To obtain a blue dye, the ivory is first stained green, and then dipped in a strong boiling solution of pearlash; or it may be boiled in tincture of indigo, and afterwards in a solution of cream of tartar.

THE CHEMIST.

CHEMISTRY.

(Continued from page 74.)

EXPERIMENTS SHOWING THE CHEMICAL ATTRACTION OF BODIES.

Chemical Attraction or Attraction of Composition, is the affinity which bodies have for each other, though of a different nature; chemical attraction being the power that forms the compound parts of any body.

Attraction of Cohesion forms all particles into a solid mass, the union of two bodies together, forming a new compound. Thus, if we place on copper filings nitric acid, the particles of the copper will mix with the acid existing there; a body in no way like either the copper or acid.

Electric Attraction.—With a warm flannel or silk handkerchief, rub a glass tube, fixed on baked wood; the glass will attract paper or feathers, and if care is taken that the wood be dry, the former will emit an electric spark, which will be both visible and perceptible to the senses. Care should be taken that the wood be dry, and the tube perfectly free from damp when used.

The Laws of Attraction of Composition.

1. The first law is, "That chemical attraction takes place only between bodies of a different nature." This may be comprehended, by the phenomena of any metal uniting with oxygen, &c.

2. The second law of chemical attraction is, "That it takes place between the most minute particles of bodies." It will be more advantageous to use iron filings, in the experiment of decomposing water, which will be found in page 74.

3. Chemical attraction "can take place between two, three, or four, or even a greater number of bodies."

4. Where chemical attraction commences, "a change of temperature always takes place at the moment of combination"—namely, by the caloric being given out by the action of chemical combination.

Experiment 5 shows the change of temperature by the union of oil of turpentine and nitric acid; the former, combining with the oxygen of the acid, causes combustion, which is generally the case in the combination of bodies, and, in general, where the compound passes from the fluid to the solid mass, as is shown in the experiment of the decomposition of water.

6. "The properties which characterise bodies, are altered or destroyed by their combination:" for instance, if we look at the oxide of any metal, it is so different to the eye, when the simple bodies are compared with the new compound; that in all respects a great change will be perceived, having in no way any relationship to the simple or elementary substances of which it is composed.

7. "The force of chemical affinity between the constituents of a body, is estimated by that which is required for their separation."

8. "Bodies have among themselves different degrees of attraction," which has been before explained.

THOS. FULLER, Jun.

(To be continued.)

EUDIOMETRY.

(Continued from page 94.)

5. Seguin's Eudiometer.

THIS consists of a glass tube, of about one inch in diameter, and eight or ten inches high, closed at the upper extremity. It is filled with mercury, and kept inverted in this fluid in the mercurial trough. A small bit of phosphorus is introduced into it, which, on account of its specific gravity being less than that of mercury, will rise up in it to the top. The phosphorus is then melted by means of a red-hot

poker, or burning coal applied to the outside of the tube. When the phosphorus is liquified, small portions of air destined to be examined, and which have been previously measured in a vessel graduated to the cubic inch, or into grains, are introduced into the tube. As soon as the air, which is sent up, reaches the phosphorus, a combustion will take place, and the mercury will rise again. The combustion continues till the end of the operation; but, for the greater exactness, Mr. Seguin directs the residuum to be heated strongly. When cold, it is introduced into a small vessel, whose capacity has been ascertained at the same time as that of the preceding. The difference of the two volumes gives the quantity of the oxygen gas contained in the air subjected to examination.

6. *Bertholet's Eudiometer.*

Instead of the rapid combustion of phosphorus, Bertholet has substituted its spontaneous combustion, which absorbs the oxygen of atmospheric air completely; and, when the quantity of air operated on is small, the process is accomplished in a short time.

Bertholet's apparatus consists of a narrow graduated glass tube, containing the air to be examined, into which is introduced a cylinder or stick of phosphorus, supported upon a glass rod, while the tube stands inverted in water. The phosphorus should be nearly as long as the tube. Immediately after the introduction of the phosphorus, white vapours are formed, which fill the tube; these vapours gradually descend, and become absorbed by the water. When no more white vapours appear, the process is at an end; for all the oxygen gas which was present in the confined quantity of air, has united with the phosphorus: the residuum is the quantity of nitrogen of the air submitted to examination.

This eudiometer, though excellent of the kind, is, nevertheless, not absolutely to be depended upon; for, as soon as the absorption of oxygen is completed, the nitrogen gas exercises an action upon the phosphorus, and thus, its bulk becomes increased. It has been ascertained, that the volume of nitrogen gas is increased to one-fortieth part; consequently the bulk of the residuum, diminished by one-fortieth, gives us the bulk of the nitrogen gas of the air examined; which bulk, subtracted from the original mass of air, gives us the proportion of oxygen gas contained in it. The same allowance must be made in the eudiometer of Seguin.

7. *Davy's Eudiometer.*

Until very lately, the preceding processes were the methods of determining the relative proportions of the two gases which compose our atmosphere.

Some of these methods, though very ingenious, are so extremely slow in their action, that it is difficult to ascertain the precise time at which the operation ceases. Others have frequently involved inaccuracies, not easily removed.

The eudiometer of Mr. Davy is not only free from these objections, but the result it offers is always constant; it requires little address, and is very expeditious. The apparatus is portable, simple, and convenient.

Take a small glass tube, graduated into 100 equi-distant parts; fill this tube with the air to be examined, and plunge it into a bottle or any other convenient vessel, containing a concentrated solution of green muriate or sulphate of iron, strongly impregnated with nitrous gas. All that is necessary to be done, is to move the tube in the solution a little backwards and forwards. Under these circumstances, the oxygen gas contained in the air will be rapidly absorbed, and condensed by the nitrous gas in the solution, in the form of nitrous acid.

N.B. The state of the greatest absorption must be marked, as the mixture afterwards emits a little gas, which would alter the result.

This circumstance depends upon the slow decomposition of the nitrous acid (formed during the experiment) by the green oxide of iron, and the consequent production of a small quantity of aëriform fluid, chiefly nitrous gas; which, having no affinity with the red muriate or sulphate of iron, produced by the combination of oxygen, is gradually evolved and mingled with the residual nitrogen gas.

The impregnated solution with green muriate, is more rapid in its operation than the solution with green sulphate. In cases when these salts cannot be obtained in a state of absolute purity, the common sulphate of iron of commerce may be employed. One cubic inch of moderately strong impregnated solution, is capable of absorbing five or six cubic inches of oxygen, in common processes; but the same quantity must never be employed for more than one experiment.

In all these different methods of analyzing air, it is necessary to operate on

air of a determinate density, and to take care that the residuum be neither more condensed nor dilated, than the air was when first operated on. If these things are not attended to, no dependence whatever can be placed upon the result of the experiments, how carefully soever they may have been performed. It is, therefore, necessary to place the air, before and after the examination, into water of the same temperature. If this and several other little circumstances have been attended to—for instance, a change in the height of the barometer, &c.—we find that air is composed of 0.22 of oxygen gas, and 0.78 of nitrogen gas by bulk. But, as the weight of these two gases is not exactly the same, the proportion of the component parts by weight will differ a little; for, as the specific gravity of oxygen gas is to that of nitrogen gas as 135 : 115, it follows that 100 parts of air are composed, by weight, of about 74 nitrogen gas, and 26 oxygen gas.

The air of the Metropolis, examined by means of Davy's endiometer, was found, in all the different seasons of the year, to contain 0.21 of oxygen; and the same was the case with air taken at Islington and Highgate; in the solitary cells in Coldbath Fields Prison, and on the River Thames. But the quantity of water contained in a given bulk of air from these places, differed considerably.

PRECIPITATION OF METALLIC GOLD

FROM THE NITRO-MURIATE ON SILK, SATIN, IVORY, &c., BY HYDROGEN GAS.

IMMERSE a piece of white satin, silk, or ivory, in a solution of nitro-muriate of gold, in the proportion of one part of the nitro-muriate to three of distilled water: while the substance to be gilded is still wet, immerse it in a jar of hydrogen gas; it will soon be covered by a complete coat of gold.

The divisibility of gold by precipitation in this manner, is astonishing; for the coating is hardly the ten-millionth part of an inch thick. The foregoing experiment may be very prettily and advantageously varied, as follows:—Paint flowers or other ornaments with a very fine camel-hair pencil, dipped in the above solution of gold, on pieces of silk, satin, &c., and hold them over a Florence flask, from which hydrogen gas is evolved during the decomposition of water by sulphuric acid and iron filings. The painted flowers, &c., in a few minutes, will shine in all the splendour of the purest gold. A coating of this kind will not tarnish on exposure to the air or washing.

Observation.—Porcelain is gilded by mixing nitro muriate of gold, gum-water, and pulverized borax. The mixture is laid on by a brush, and the porcelain is burnt in an oven. The gold is thus revived with great splendour. Porcelain and other wares may be platinized, silvered, tinned, and bronzed, in a similar manner.

W. HOPKINSON.

CAUSE OF STEEL TURNING BLUE.

To the Editor of the Penny Mechanic and Chemist.

SIR,—Not long ago, a letter appeared in your valuable Magazine, from "Mr. Bilbrough," relative to the blue colour which steel acquires by being heated. "Mr. Bilbrough" is in error when he states, that the colour is not owing to the oxygen of the air; that it is so, is easily proved. It is an oxide of iron, which, by being touched with any weak acid, is immediately dissolved, forming a solution of iron, which may be detected by tincture of galls, or ferrocyanide of potassium. If the steel be heated, when not in contact with oxygen, no blue colour is produced. "Mr. Bilbrough" should have reflected a little, before he formed an opinion contrary to chemists, who state, that steel is not blued when heated in an atmosphere of hydrogen. Hydrogen does not explode when heated, unless oxygen is present in it. Many tyros in chemistry have been greatly surprised when, on putting a light to a stream of hydrogen, an explosion has followed. They forget that all vessels, which they make use of to procure the gas, are full of air; this air must be expelled, before any attempt is made to collect the gas for experiment, by letting the gas escape into the air for some time, when, at last, the vessels will be cleared of atmospheric air, and the gas escape pure. The detonation which is heard when impure hydrogen is heated, is owing to its combining with the oxygen mixed with it; steam is formed, and, by the great heat which that combination gives rise to, the steam is so suddenly expanded as to cause the explosion.

I remain yours respectfully,

J. REEVES, Jun.

MISCELLANEA.

Animal Strength.—There is a certain load which an animal can just bear, but cannot move with it; and there is a certain velocity with which an animal can move, but cannot carry any load. In these two circumstances it is clear, that the exertion of the animal can be of no avail as a mover of machinery. These are, as it were, the extremes of the animal's exertion, where its effect is nothing; but, between these two extremes, there must be weights and velocities with which the animal can move, and be more or less efficient. It has been found by investigation, that the maximum effect of an animal will be, when it moves with one-third of its greatest speed, and carries four-ninths of the greatest load it can bear. Thus, if the greatest speed at which a man can travel or run, without a load, be six miles per hour, and if the greatest load which he can bear, without moving, be $2\frac{1}{2}$ cwt. or 280 lbs., then $\frac{280\times4}{9}=124.4$ lbs. the load, and $\frac{6}{3}=2$ miles per hour, the speed with which a man will produce the greatest useful effect.

Test of Gas.—A solution of acetate of lead (commonly called sugar of lead), spread upon white paper, affords a very ready mode of ascertaining the purity of gas. If the paper be exposed to the stream of pure gas, it retains its whiteness; but, if the gas be impure, it will produce a different shade, according to the degree of impurity, varying from a light brown to a black. Such impurities have the effect of clogging the tubes and injuring the burners—circumstances tending to make cheap gas beneficial to gas-fitters, and, therefore, very dear to consumers.

W. F.

American Draining-Machine.—John G. Shaw Lefevre, Esq., F.R.S., presented, on the part of the Board of Trade, an American draining-machine, invented by P. D. Henry, of New Orleans, in the United States. The object of this machine is, to raise water from a low place or reservoir, to a higher one; and the inventer proposes to accomplish this purpose, by means of a hollow revolving hydraulic wheel, placed vertically at one-third its depth in the water, and divided into scooped compartments, provided with valves, which, as the wheel turns round, admit the water and retain it, until a certain elevation above the surface has been attained, when the enclosed water falls back, along radiating compartments, towards the centre of the hollow wheel, and is carried away by a cylinder in a continuous stream. Mr. Henry enters into a detailed account of the particular arrangements by which this effect is produced in the most economical and efficient manner, and claims, as the peculiar merit of his invention, the tangential mode in which the compartments of the hollow wheel are arranged, in reference to the cylindric conduit through its centre, and the contrivance of the spoons for scooping up the water when the reservoir is low. Above the hydraulic wheel, when in use, is placed a man on a frame-work, who causes the great wheel to revolve, by turning the handle of cog-wheels acting on its circumference; and the inventer states, that he found a wheel of six feet in diameter, constructed on this principle, and worked by one man, capable of raising 200 gallons of water per minute. The Council directed that their best thanks should be returned to Mr. Shaw Lefevre for this communication, and that the paper should be referred to the consideration of the Journal Committee.

Horse-power is reckoned as constant, but if they work but eight hours a-day, a one-horse engine is equal to the work of 300 horses. Horse-power, in steam-engines, is calculated as the power which would raise 33,000 lbs. a foot high in a minute, or 90 lbs. at the rate of four miles an hour. One-horse power is equal to the lifting by a pump 250 hogsheads of water ten feet high in an hour. Or it will drive 100 spindles of cotton-yarn twist; or 500 spindles of No. 48 mule-yarn, or 1000 of No. 110, or twelve power-looms. One-horse power is produced by 16 lbs. of Newcastle coals, 50 lbs. of wood, or 34 lbs. of culm.

INSTITUTIONS.

LECTURES DURING THE WEEK.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, March 24, William Ball, Esq., on the Comic Literature of the Kingdom. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, March 21, Mr. W. H. Murrell, on the State and Prospects of British India. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, March 24, E. W. Elton, Esq., on the Genius of Shakspeare. At eight o'clock.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, March 22, Mr. Mee, on Geology. At eight o'clock.

QUERIES.

I shall feel obliged to any reader who may be disposed to supply me with a copy of the instrument (the design and printed description) for cutting fusees, from F. Berthoud's "Essai sur l'Horlogerie," Paris, 1786. A. M.

What is the composition which stains wood a sort of dark brown, nearly approaching rose-wood, and is used by the makers of fishing-rods? Also, what apparatus do these artisans employ, to bore the buts and other parts of fishing-rods? A. M.

1. How to polish ivory? 2. Of what are the flexible tubes made and covered, that are used for pipes for smoking? 3. A description of M'Farlane's calculating planisphere? 4. A receipt for glue that will stand wet? G. S., Jun.

The method of setting out cog-wheels and gearing generally, or where can I purchase a cheap work on that subject? M. Lane.

The best method of taking off old varnish from globes and maps? J. F.

How to make acid and horehound drops, so that they will not spoil by exposure to the air? Also, how capsules of copaiba are made? S.

Can any of your readers inform me of a very powerful black dye, that will dye very hard substances without the use of acids? A. S.

What are mineral teeth made of; or in what work can I obtain any information upon the subject? D. P.

What is Thomas's mineral succedaneum composed of? The exact proportions will greatly oblige W. Rees.

Where can Robinson's "Engineer's Assistant" be purchased? G. S.

I have an electrical machine to sell, with electrical apparatus to experiment with, in excellent condition, as good as new, and is a bargain not to be met with every day. A letter addressed to "W. Hopkinson, Dispensing Chemist, No. 70, Broughton Road, Salford, Manchester," will meet with immediate attention.

W. Hopkinson.

ANSWERS TO QUERIES.

Ink for Writing on Lithographic Stone.—Wax, 16 parts; tallow, 6 parts; hard tallow soap, 6 parts; shell-lac, 12 parts; mastich in tears, 8 parts; Venice turpentine, 1 part; lamp black, 4 parts. The mastich and lac, previously ground together, are to be heated, with care, in the turpentine; the wax and tallow are to be added after they are taken off the fire; and, when their solution is effected, the soap shavings are to be thrown in; lastly, the lamp black is to be well intermixed. Whenever the union is effected by heat, the operation is finished; the liquor is left to cool a little, then poured out on tables, and, when cold, cut into square rods.

To make Pink Ink.—Pink ink may be made by infusing, three or four days, Brazil wood, chopped into small pieces, in vinegar; the infusion must then be boiled for an hour, strained and thickened slightly with gum Arabic and sugar. A little alum improves the colour. About two ounces of Brazil wood to a pint of vinegar, is the proper quantity.

To Prepare Red Lead.—This is prepared by calcining lead upon a reverberatory hearth with a slow fire, and frequent renewal of the surface with a rake, till it becomes an oxide, taking care not to fuse it. The calcined mass is triturated into a fine powder in a paint-mill, where it is elutriated with a stream of water, to carry off the finely-levigated particles, and to deposit them afterwards in tanks. The powder, thus obtained, being dried, is called massicot; it is then put into trays, and piled up on the reverberatory hearth, whereby it absorbs more oxygen, and becomes partially red lead. This, after being stirred about, and subjected to a similar low calcining heat again, will be red lead. H. C.

If "A. B." will read two papers of mine on organ-pipes, one in No. 62, and one in Nos. 68 and 69, he will perceive that the same scale cannot answer for different kinds of pipes; as it is by making them on different scales, that the variety of tone is produced. He will there find instructions for drawing scales; and, as a general rule, the smaller the scale—that is, the less the diameter of the pipe—the longer it must be to produce the same note. Also, having any note the octave above, must be half the length and three-fifths of the diameter; and the octave below, double the length, and its diameter two-thirds more. The thickness of the wood is immaterial, so that it is not so thin as to bend. When the diameter does not exceed one inch and a half, six-cut or seven-cut pine plank, as it is called by timber-merchants, is suitable—that is, about a quarter of an inch thick. For larger pipes, something thicker is necessary; five-cut, or about three-eighths of an inch, for the next octave, and so on.

"W. Courtney." A green-glass wine-bottle will do for the cylinder of an electrical machine. He may cut the neck off the bottle in either of the following ways:—First make the poker red hot, and draw it round that part of the bottle he wishes to separate from the other, after which, plunge the bottle immediately into a vessel of cold water, and the piece falls off; secondly, dip a piece of worsted into a little turpentine, and tie it round the part he wishes to separate, and inflame it; when the flame is burnt out, immerse it in cold water as before. W. Hopkinson.

TO CORRESPONDENTS.

A Subscriber, 15, Southampton Street, *is informed, that his communication is an advertisement, and would be liable to duty.*

P. Lackwood.—*It was linseed* meal *and water we recommended for a tubing, not linseed* oil. *Any kind of ware will do, and the ingredients are very cheap.*

M. Lane.—*A carriage, worked by manual labour, has never yet been found to answer on common roads, the resistance being too great for the power.*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

Nos. 73 & 74, THIRD SERIES. | SATURDAY, MARCH 26. PRICE TWOPENCE. | Nos. 321 & 322. OLD SERIES.

CUTTING SCREWS IN THE LATHE.

FIG. 4.

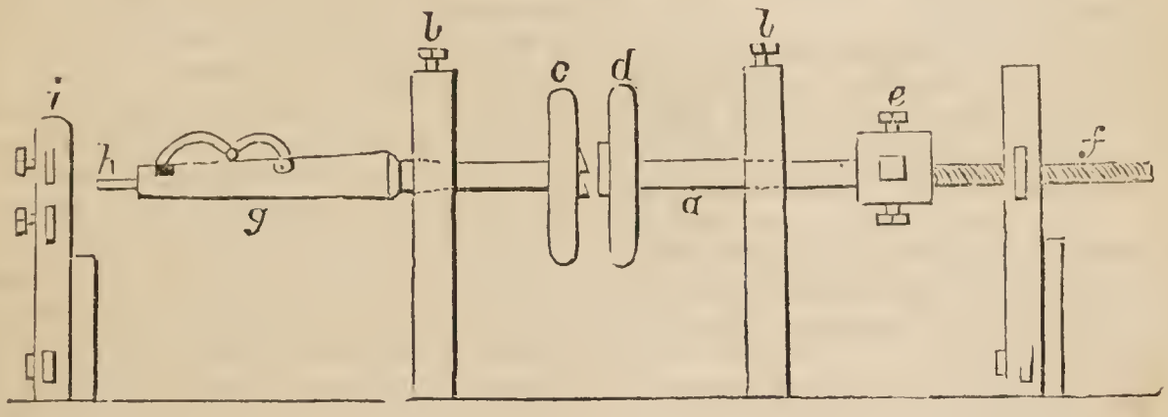
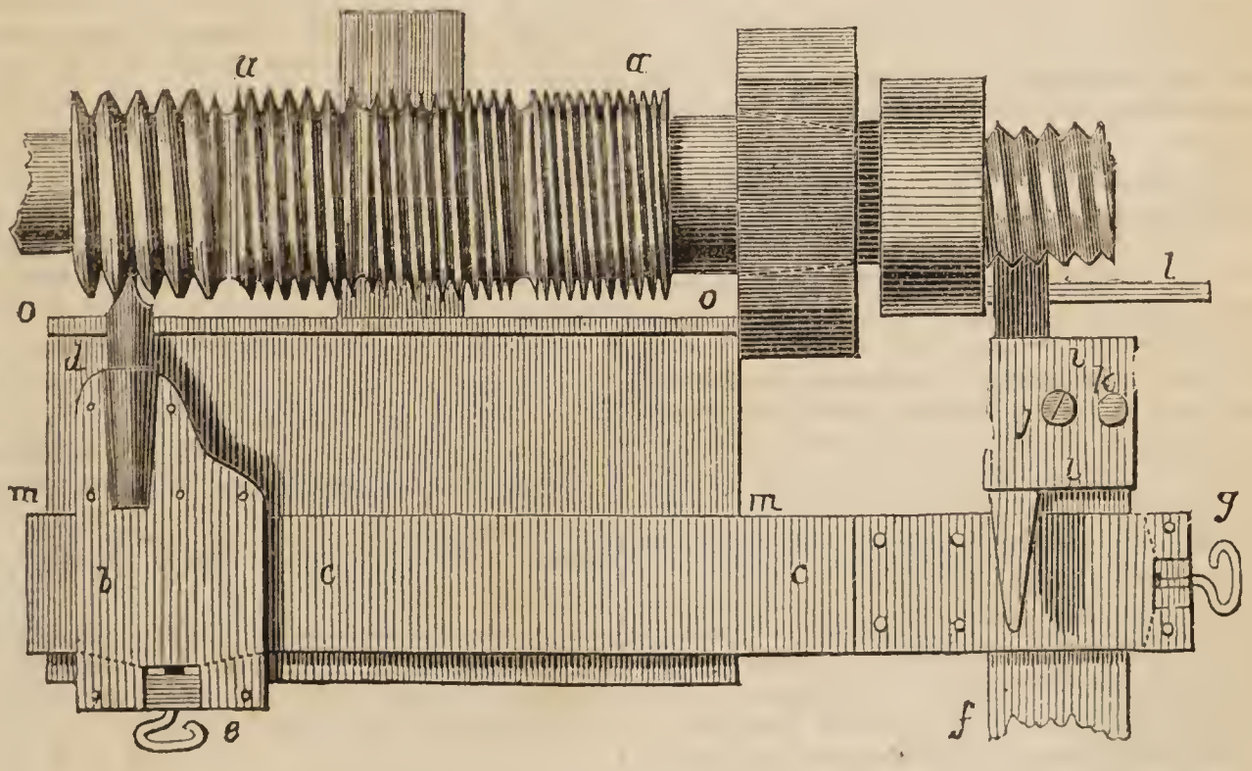


FIG. 5.



Vol. VIII.—Nos. 14 & 15.] City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ON CUTTING SCREWS IN THE LATHE.

No. II.

(See Engraving, front page.)

10. HAVING explained the mechanical principles by which a continuous spiral line may be traced on any cylinder, our next step is to apply this elementary knowledge, to enable us to cut the helical thread of a screw on the surface of a metal or other pin, while the same is revolving* in a lathe: this may be done, *first*, by a rotary and rectilinear motion being communicated immediately from the mandrel to the substances to be operated on; *secondly*, by a similar motion being given to the apparatus which carries the tool or cutter.

Of the *first* description is the traversing mandrel, in its various modifications, which may be ranged under three heads:—first, where the guide-screw is attached to the left-hand end of the mandrel; secondly, where the pattern-screws are cut upon, and form a portion of the mandrel; and, thirdly, where the model-screws are hollow, and may be removed from the mandrel at pleasure.

11. In the course of our inquiry, we shall have occasion to describe, either in detail or partially, some of the many contrivances which have been invented for screw-cutting; but, keeping in view the great object of this Journal, we shall select for illustration those machines which are least expensive, most readily reducible to practice, and best calculated for general use.

We think it needless to enter into any lengthened account of the traversing mandrel, for two reasons—first, the arrangement is defective,* and, consequently, unsatisfactory in its performance; secondly, it is very clear, that a mandrel traversing in the way we have pointed out, must transfer a like motion to any cylinder affixed to it, and moving in the same plane.

12. A very simple apparatus for cutting screws of small dimensions, is shown at fig. 4. Here we have the moveable guide or pattern-screw, already alluded to; A is a steel cylindrical mandrel, generally about twelve inches long, revolving in suitable collars in the puppets, B B, and driven by an endless band, passing round the pulley, C; D is a loose pulley; at E, is an iron box, made to open, and firmly secured by screws, the end of the *guide* or *regulating* screw, F, of which there must be as many provided as there are varieties in the threads of the screws to be cut. The length of this screw depends on circumstances; it should not be less than four or five inches. G is a chuck, in which the pin or blank to be tapped is fixed, by means of a kind of hasp; its end is shown projecting at H, whence it is made gradually to traverse in a right line by the revolution of the guide-screw, until it reaches and passes between a pair of fixed dies at I; the thread of which must coincide, in every respect, with that of the guide-screw.

13. The best arrangement of hollow screws with which we are acquainted, is that of the late ingenious Mr. Samuel Varley;† this mode he properly designates *copying screws by the lathe*, using, as a guide, one of the original true screws, which are cut on one cylinder, and fitted on the mandrel. Mr. Varley's plan appears very effective, and by no means expensive; the plates are too numerous and elaborate for insertion; we regret the necessity imposed on us, but we must content ourselves with a description of the more important parts, shown in fig. 5, which we give nearly in Mr. Varley's own words. A piece, B, is made to slide on the connecting bar, C, for the purpose of adjusting the guide-pin, D, to suit the required thread; the screw, E, secures it when so adjusted; another sliding bar, F F, moves at right angles to the bar, C, having an end screw, G, to fasten it; this carries the screw-tool, H, which, of course, must correspond with the guide in use; this screw-

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* As a general principle, we may observe, that uninterrupted circular motion is not calculated for screw-cutting, more especially with a traversing mandrel, an alternating circular motion being required; and this cannot be communicated, without much practice, from the fly-wheel to the mandrel, by the impulse given by the foot to the treadle. Now whether we employ a large detached wheel, or the common foot-wheel, some little arrangement is necessary to procure the desired motion. In the former case, the large wheel must be turned backwards and forwards by its winch, through a space proportional to what the guide-screw will allow. In the latter, a cord, descending from a spring or elastic pole, must be coiled round the pulley of the mandrel, and attached to the treadle, the range of which may be suited to the occasion. Either of these contrivances gives a reciprocating rotary movement, which is precisely that wanted for cutting a screw. The reader may consult, for more minute details, "Nouveau Manuel du Tourneur par Dessables," tom. i., pages 221 and 298.

* Because, setting its work out of the question, it sacrifices the character and capability of a lathe for general use, to one object.

† Communicated by his nephew, Cornelius Varley, to the Society of Arts. See "Transactions of Society of Arts," vol. xliii., pp. 90-3.

tool is secured to the bar, F, by the clamp-plate, I I; the tool is tightened by the screw, J, and additional pressure is given by the screw, K; L L is a rest, which supports the tool while cutting; M M, a stage or support for the other end of the bar or sliding piece, B; it has a metal ridge, O O, in order to support the guide-pin, D. To secure the concentric truth of the screw, there is an adjusting screw, G, underneath the screw-tool, H. The point of this screw bears against the rest, and thus determines the depth of the thread or diameter of the screw; it also determines the parallelism or taperness of the screw, according as the rest, L, is set parallel or inclined to the axis of the screw. Thus a very complete command of the screw, in all its dimensions, is obtained.

To use the tool, the left hand holds the end piece, B, and keeps the guide-pin pressed close into the thread of the guide, A, while the right hand holds the bar, F, as a handle to the turning tool, B, and secures the cut. One great advantage of Mr. Varley's method is, that the lathe always turns in one direction, alternate or reciprocating circular motion not being required; but when the cutter, H, touches the shoulder of the screw, both it and the guide-pin are suddenly drawn out of contact by a parallel motion of both hands, and brought forward to begin again at the point of the screw, and this motion is repeated till the screw is finished. There is no occasion to inspect the guide-point, D, as the left hand feels when it is in contact. *

14. If an outside screw-tool, of the usual form, be applied to the external surface of a cylinder revolving in a lathe, and there held stationary, it will evidently cut as many parallel and equidistant circles as there are teeth in the tool. Now suppose a regular rectilinear motion to be given to the tool, as the work continues to revolve, its teeth, instead of describing circles, will trace the spiral thread of a screw; and if this movement be so accurately performed that, during one revolution, the tool shall advance a distance exactly equal to the space between two adjacent teeth, one complete spiral will thus be cut, and the tool, by means of its teeth, will naturally follow the lead; the second tooth falling into the spiral cut by the first, which will still preserve a helical line, till a third tooth becomes engaged, then a fourth, and so on, until the required screw be completed.

15. This invariable precision being obviously beyond the reach of manual dexterity—although very excellent screws are daily cut, by experienced workmen, in the manner just described—yet, being necessarily far from perfect, and, as the operation demands a degree of skill rarely attained, recourse is had to a simple arrangement of toothed wheels, by which we are enabled to impart a steady rectilinear movement to the rest or carriage that supports the tool, and thus produce every variety of screw with singular accuracy.

The following note refers to page 83, No. 70:—It is to be regretted, that this excellent mechanical arrangement has not received the attention it deserves, as it is susceptible of the most accurate adjustment; in proof, whereof, I extract the following notice of Mr. Barton's curious engine for ornamenting steel and other metals, by minute division:—"The engine used by Mr. Barton, was constructed, I apprehend, by the late celebrated Mr. Harrison himself; its merits depend chiefly on the correctness of the screw; the apparatus for cutting which, by an *inclined plane*, accompanies the engine." See farther, "Gill's Technical Repository," vol. iii., page 81.

DESCRIPTIVE GEOLOGY.

(Continued from p. 91.)

NEWER PLIOCENE PERIOD *(continued)*.

ONE of the most remarkable circumstances with respect to erratic blocks, is the distance they are sometimes found from the parent rock. Thus, masses of the granite of Crisfel, a well-known mountain in the stewartry of Kirkcudbright, lie scattered about near Newcastle, on the opposite side of the Solway. Huge specimens of Norwegian mountains are likewise deposited on the east coast of England. Blocks of granite are found on the mountains of Potosi, while the nearest granite rocks are in Tucuman, about 400 leagues off.

Many imaginary causes have been invented to account for the transportation of these masses of rock from their original localities. None, however, seems to have

* The arrangement of this machine is very severely, and, as we consider, most unjustly criticised, in the appendix to "Nouveau Manuel du Tourneur." This appendix was got up, we believe, by a M. Mapod, who styles himself, after the bombastic manner of his nation, "Tourneur-Mecanicien;" and, as M. Mapod's knowledge of Mr. Varley's machine is evidently derived from some other source than the original communication by the inventer's relation, he should, in the first place, have ascertained, whether the mechanical details which moved his bile, originated with Mr. Varley, or had been introduced by the blunders of a translator. See tom. ii., pp. 228—37; also, "Industriel," No. vii.

the effect desired, so well as the *glacial theory*, lately brought prominently before the geological world, by M. Agassiz. According to this very distinguished naturalist, there is evidence, from the peculiar effects left by glaciers in the valleys of Switzerland, and on the surface of the Jura Mountains, that the icy mantle, which now wraps the High Alps, once filled the valleys for miles beyond its present limits, and rendered it a mere glacier movement across an ice-filled hollow, which carried the blocks of Mont Blanc and the Valorsine, across the lake of Geneva, to the Jura. Recently ("Geological Transactions" for Nov. and Dec., 1841) Dr. Buckland and Mr. Lyell have endeavoured to prove, that glaciers anciently covered large tracts of the Caledonian and Cumbrian regions.

It is also the opinion of M. Agassiz, that the icy covering thus attempted to be demonstrated, by its remaining effects in the mountainous parts of Great Britain, &c., once extended over the north of Europe, and the north of Asia and America; and that in this mass of ice, the elephants and other mammalia, found in the frozen mud and gravel of the arctic regions, were imbedded at the time of their destruction.* To the quick melting of this immense mass of ice, and the currents of water which resulted, is attributed the transport and deposition of the masses of irregularly-rounded boulders and gravel which fill the bottom of the valleys; innumerable boulders having, at the same time, been transported, together with mud and gravel, upon the masses of the glaciers then set afloat. ("Etudes sur les Glaciers de la Suisse," 8vo., Neuchâtel, 1841.)

GLACIAL THEORY.

I shall take this opportunity to introduce the reader to some curious particulars respecting the glacial theory, collected chiefly from a paper read by M. Agassiz, at a meeting of the Geological Society of France in 1839, from the work just published by him, and from the first Number of the "Geologist," Jan., 1842.

Wherever, in temperate latitudes, there are mountains of such height, as to be elevated into the region where an almost constant congelation prevails, their upper parts become covered with sheets of ice, termed glaciers. The texture of each glacier is not solid, but rather spongy, being penetrated in every direction by chasms, crevices, or cracks. In summer, when a certain melting takes place, water sinks into, and fills up, the chinks. In winter, this water freezes once more, and, in freezing, of course expands. The expansion produces a general dilatation of the glacier. The sheet accordingly descends along the slopes of the mountain, wherever an open and downward space allows it room to pass. It may be remarked, that the whole sheet does not descend equally. The outer part being most liable to cracking, and becoming dilated, moves on faster than the under part next to the sides of the mountain.

The alternations of temperature act upon the rocks precisely in the same manner as upon the glacier itself; and, from first being cracked in various directions by the absorption and subsequent congelation of water, large pieces become loosened by succeeding frosts, and, in the end, are detached by the first avalanche, or glacial progress; these, in their descent, become gradually diminished in size, in consequence of striking against the mountain in their progress, and are subsequently scattered; the smaller pieces acquire a degree of heat, which causes them to melt the ice upon which they rest, and penetrate into the mass; the larger, being impervious on account of their size, often remain isolated upon the ice beneath them, which, from being thus protected, has withstood the heat; while the surrounding glacier, from being exposed, has long since melted away. It is only when the position of these isolated blocks has become less secure from subsequent and gradual changes in the icy pedestal upon which they rested, that they are precipitated by the force of gravitation.

It is from these causes that the glaciers are almost always terminated, and their courses marked, by large mounds of fragments of rock, which have received the appellation of *moraines*, and which exist under determinate circumstances. M. Agassiz has classed them under three distinct names—viz.

Terminal moraines, when they form the extremity of a glacier.

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* This alludes to the following circumstances:—In 1799, there was discovered in an iceberg, on the north shore of Siberia, a singular mass, which the fishermen observed for several winters, without being able to ascertain what it was, when, in 1803, in consequence of the thawing of the ice, it became evident that it was a large elephant-like animal, of which one of the tusks was proportionate. We are indebted to Mr. Stokes for an account of this animal, and for the drawing of the skeleton (Vol. 8, "Quarterly Journal," First Series, page 95.) See farther, page 67, Brande's "Outlines of Geology," 1829.

Lateral moraines, when they form the lateral boundary of a glacier.

Medial moraines, when they are formed by the junction of those of any two or more valleys.

We must now look at the effects which the descent of the glaciers have upon the surfaces of mountains. According to Agassiz, a glacier levels the surface of the subjacent mountain by friction; polishing it, in some instances, as perfectly as could be done by the marble-cutter, and alike smoothing down the hard crystals which may be enclosed in the rock and the body of the rock itself. It rounds off all inequalities, transforming them into round smooth protuberances. Where the nature of the rock admits, it scoops out furrows from an inch to a foot in diameter, the length of which is always, of course, in the direction of the movement of the glacier. It also, in some places, makes spoon-shaped hollows, which it is not easy to account for. The small pieces fixed in the under surface of the glacier, and the hard sandy grains pressed between it and the mountain, make sharp indentations or scores (technically, striæ) on the polished surfaces below, and always in the same direction as the groovings.

Such are the established phenomena of existing glaciers—a constant downward movement in themselves, groovings and scores formed by them on the surfaces of the mountains, and moraines left at their extremities and sides.

When we keep in mind that the lower extremity of a glacier must correspond with the lowest stratum of the atmosphere where constant freezing prevails, we cannot but be greatly interested in the facts observed by M. Agassiz—viz. that moraines resembling those skirting the present glaciers, but grown over by turf and vegetation, exist at various places in the Swiss Alps, far below the present lowest point of congelation; showing that the glaciers have receded towards the upper parts of the mountains, or that the space originally covered by them has been contracted. In the intermediate space, wherever the rock has been laid bare, this conclusion is found to be supported by groovings and striæ, exactly resembling those found underneath the existing glaciers, and undoubtedly produced by the same cause. The position of the ancient moraines is exactly such as might be expected in the respective local circumstances, if we suppose the glacier to have once extended so far down. For example, in the Lower Valais, a lateral moraine is traceable along the sides of the valley. On the Jura range are two ancient terminal moraines, extending in zones round the hills The celebrated vale of Chamounie, contains no fewer than seven concentric curved moraines, the lowest of which, about 200 feet above the plain, forms the situation of the village of Tines. In such cases, we must suppose the glacier to have at one time extended to the outermost moraine, then to have been contracted, so as to extend only to the sixth. After that had, in the course of time, been formed, another change of temperature must have taken place, and the glacier would recede to the point where the fifth moraine now rests; and so on, till it finally receded to the point where its skirt is now seen.

Many naturalists, years ago, had observed these appearances, but no one could divine their cause, till M. Agassiz, instructed by the speculations of modern geology, suggested the former existence of a layer of ice which covered all the great Swiss valleys, and gradually receded, in obedience to changes of temperature, leaving the moraines as marks of its various limits at various times. He published this speculation in 1839; being then aware that a gentleman named Sesstroem had observed scored rocks in Sweden, he boldly concluded that, at a certain epoch, the whole of Europe must have been covered with ice. This epoch he presumed to have occurred while the earth was peopled by the animals whose remains are found in the diluvium.

PNEUMATICS.

No. II.

I STATED in my last paper on pneumatics, that the air presses in every direction, which will become obvious from the following experiments:—In a tall phial let an orifice be made, about three inches from the bottom; stop this orifice. Through a cork in the neck of the bottle insert a long tube, open at each end, and let the lower end be below the orifice in the side of the bottle; the mouth of the bottle being closed up about the tube, pour water into the tube till it is full; upon opening the orifice, the water will be discharged, till its surface in the tube is level with the orifice; after which, no water will flow from it, because the external lateral pressure of the air balances the perpendicular pressure upon the water in the tube. If a conical wine-glass be filled with water, and covered with a loose piece of paper or cardboard, on inverting the glass, the water will be kept from falling by the

upward pressure of the air. To show the lateral pressure of the air, the following may serve:—If a small vessel be perforated with holes at the bottom, but closed at top, the upward pressure of the air will keep the water within the vessel, as will appear by successively stopping and unstopping a small hole in the top. When the end of a tube or pipe is immersed in water, and the air extracted from the tube, the water will rise in it to the height of about thirty-three feet above the surface of the water in which it is immersed, but will rise no higher; and this is the greatest height to which water can be raised above the surface of a well by the common process: therefore, unless the piston or bucket goes within thirty-three feet of the surface of the water in the well, it will never rise above the piston. Now as it is the pressure of the atmosphere on the surface of the water in the well, which is the cause of it so rising, the action of the pump may be briefly explained:—When the rod of the pump is forced down, the bucket compresses the air in the lower part of the pump-tree, which, being elastic, forces its way out of the tree through the valve; so that, when the bucket is again raised, that part of the pump-tree under the bucket is void of air; and the weight of the atmosphere, pressing upon the body of water in the well (as above stated), forces up a column of water to supply its place; the next stroke of the pump-rod causes another column of water to rise; and thus, as long as the bucket fits the pump-tree close enough to produce a vacuum, a constant stream of water may be drawn from below. By cutting a piece of writing-paper in the form of a valve, and adapting it to the top of an ale-glass, it will be no difficult thing to understand how the successive columns of water force up the valve in the tree, and how that valve supports the water when raised, and prevents its return. When a child sucks at the breast, it forms a vacuum with its mouth, and the milk flows on the same principle. In like manner the boys form a vacuum between a piece of leather tied to a string, and a small stone, and, by means of the pressure of the atmosphere, are enabled to lift the stone from the earth, and carry it about suspended by the leather. It is the action of the atmosphere which enables the limpet to attach itself to the rock. It forms a vacuum in its pyramidal shell, and the pressure of the atmosphere supports it, where it wishes to remain, without any farther exertion of its own. I may here remark, that these effects are attributed by some, to what they call suction; but no such principle as suction exists; the pressure of the atmosphere is fully sufficient to account for them all.

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HISTORY AND PROGRESS OF THEORETICAL AND PRACTICAL MECHANICS.

No. I.

From the most authentic sources we discover, that the honour of laying the foundation of theoretical mechanics, is due to Archimedes, who flourished about 250 years B. C., and who, in addition to his inventions in geometry, discovered the general principles of hydrostatics. In his two books, "De Equiponderantibus," he has demonstrated, that, when a balance with unequal arms is in equilibrio, by means of two weights in its opposite scales, these weights must be reciprocally proportional to the arms of the balance. From this general principle, all the other properties of the lever, and of machines referrible to the lever, might have been deduced as corollaries, but Archimedes did not follow the discovery through all its consequences. In demonstrating the leading property of the lever, he lays it down as an axiom, that, if the two arms of the balance are equal, the two weights must also be equal when an equilibrium takes place; and then shows, that, if one of the arms be increased, and the equilibrium still continue, the weight appended to that arm must be proportionally diminished. This important discovery conducted the Syracusan philosopher to another, equally useful in mechanics. Reflecting on the construction of his balance, which moved upon a fulcrum, he perceived that the two weights exerted the same pressure on the fulcrum, as if they had both rested upon it. He then considered the sum of these two weights as combined with a third, and the sum of these three as combined with a fourth; and saw, that, in every such combination, the fulcrum must support their united weight, and, therefore, that there is in every combination of bodies, and in every single body which may be conceived as made up of a number of less bodies—a centre of pressure or gravity. This discovery Archimedes applied to particular cases, and pointed out the method of finding the centre of gravity of plane surfaces, whether bounded by a parallelogram, a triangle, a trapezium, or a parabola. The theory of the

inclined plane, the pulley, the axis in peritrochio, the screw, and the wedge, which was first published in the eighth book of Pappus's mathematical collections, is generally attributed to Archimedes. It appears, also, from Plutarch and other ancient authors, that a greater number of machines which have not reached our times, was invented by this philosopher. The military engines which he employed in the siege of Syracuse, against those of the Roman engineer Appius, are said to have displayed the greatest mechanical genius, and to have retarded the capture of his native city.

The construction of machines must have arrived at considerable perfection before the theory of equilibrium, or the simplest properties of the mechanical powers had engaged the attention of philosophers. We accordingly find that the lever, the pulley, the crane, the capstan, and other simple machines, were employed by the ancient architects in elevating the materials of their buildings, long before the dawn of mechanical science; and the military engines of the Greeks and Romans—such as the catapultæ and balistæ—exhibit an extensive acquaintance with the construction of compound machinery. In the splendid remains of Egyptian architecture, which in every age have excited the admiration of the world, we perceive the most surprising marks of mechanical genius. The elevation of immense masses of stone to the tops of their stupendous fabrics, must have required an accumulation of mechanical power, which is not in the possession of modern architects.

Among the various inventions which we have received from antiquity, that of water-mills is entitled to the highest place, whether we consider the ingenuity they display, or the useful purposes to which they are subservient. In the infancy of the Roman republic, the corn was ground by hand-mills, consisting of two millstones. one of which was moveable, and the other at rest. The upper millstone was made to revolve, either by the hand applied directly to a winch, or by means of a rope winding round a capstan. The precise time when the impulse or the weight of water was substituted in the place of animal labour, is not exactly known. From an epigram in the "Anthologia Græca," there is reason to believe, that water-mills were invented during the reign of Augustus; but it is strange, that in the description given of them by Vitruvius, who lived under that emperor, they are not mentioned as of recent origin. The invention of wind-mills is of later date. According to some authors, they were first used in France in the sixth century; while others maintain, that they were brought to Europe in the time of the crusades, and that they had long been employed in the East, where the scarcity of water precluded the application of that agent to machinery.

The science of mechanics seems to have been stationary till the end of the sixteenth century. In 1577, a treatise on mechanics was published by Guidus Ubaldus, but it contained merely the discoveries of Archimedes. Simon Stevinus, however, a Dutch mathematician, contributed greatly to the progress of the science. He discovered the parallelogram of forces, and has demonstrated, in his "Statics," published in 1586, that, if a body is urged by two forces in the direction of the sides of a parallelogram and proportional to these sides, the combined action of these two forces is equivalent to a third force acting in the direction of the diagonal of the parallelogram, and having its intensity proportional to that diagonal. This important discovery, which has been of such service in the different departments of physics, should have conferred upon its author a greater degree of celebrity than he has actually enjoyed. His name has scarcely been enrolled in the temple of Fame, but justice may yet be done to the memory of such an ingenious man. He had, likewise, the merit of illustrating other parts of statics; and he appears to have been the first who, without the aid of the properties of the lever, discovered the laws of equilibrium in bodies placed on an inclined plane. His works were reprinted in the Dutch language in 1605. They were translated into Latin in 1608, and into French in 1634; and in these editions of his works, his "Statics" were enlarged by an appendix, in which he treats of the rope-machine, and on pulleys acting obliquely.

In 1572, the science of mechanics assumed a new form in the hands of Galileo. He wrote a small treatise on statics, which he reduced to this principle—that it requires an equal power to raise two different bodies to altitudes in the inverse ratio of their weights; or that the same power is requisite to raise ten pounds to the height of 140 feet, and twenty pounds to the height of fifty feet. This fertile principle was not pursued by Galileo to its different consequences. It was left to Descartes to apply it to the determination of the equilibrium of machines, which he did in his explanation of machines and engines, without acknowledging his obligations to the Tuscan philosopher. In addition to

this new principle, Galileo enriched mechanics with his theory of local motion. This great discovery has immortalized its author; and whether we consider its intrinsic value, or the change which it produced in the physical sciences, we are led to regard it as nearly of equal importance with the theory of universal gravitation, to which it paved the way. The first hints of this new theory were given in his "Systema Cosmicum," Dialogus II. The subject was afterwards fully discussed in another, published in 1638. This work is divided into four dialogues; the first of which treats of the resistance of solid bodies before they are broken; the second points out the cause of the cohesion of solids; in the third he discusses his theory of local motions, comprehending those which are equable, and those which are uniformly accelerated; in the fourth, he treats of violent motion, or the motion of projectiles; and, in an appendix to the work, he demonstrates several propositions relative to the centre of gravity of solid bodies. In the first of these dialogues he has founded his reasoning on principles which are far from being correct, but he has been more successful in the other three. In the third dialogue, which contains his celebrated theory, he discusses the doctrine of equable motions in six theorems, containing the different relations between the velocity of the moving body, the space which it describes, and the time employed in its description. In the second part of the dialogue, which treats of accelerated motion, he considers all bodies as heavy, and composed of a number of parts which are also heavy. Hence he concludes, that the total weight of the body is proportional to the number of the material particles of which it is composed, and then reasons in the following manner:—As the weight of a body is a power always the same in quantity, and as it constantly acts without interruption, the body must be continually receiving from it equal impulses in equal and successive instants of time. When the body is prevented from falling by being placed on a table, its weight is incessantly impelling it downwards; but these impulses are incessantly destroyed by the resistance of the table, which prevents it from yielding to them. But where the body falls freely, the impulses which it perpetually receives are perpetually accumulating, and remain in the body unchanged in every respect, excepting the diminution which they experience from the resistance of air. It, therefore, follows, that a body falling freely is uniformly accelerated, or receives equal increments of velocity in equal times. Having established this as a definition, he then demonstrates, that the time in which any space is described by a motion uniformly accelerated from rest, is equal to the time in which the same space would be described by a uniform equable motion, with half the final velocity of the accelerated motion; and that in every motion uniformly accelerated from rest, the spaces described are in the duplicate ratio of the times of description. After having proved these theorems, he applies the doctrine, with great success, to the ascent and descent of bodies on inclined planes.

It was about the year 1664, that steam began to be employed as the first mover of machinery. This great discovery has been ascribed by the English to the Marquis of Worcester, and by the French to Papin; but it is almost certain, that, about thirty-four years before the date of the Marquis's invention, and about sixty-one years before the construction of Papin's digester, steam was employed as the impelling power of a stamping-engine by one Brancas, an Italian, who published an account of his invention in 1629. It is extremely probable, however, that the Marquis of Worcester had never seen the work of Brancas, and that the fire-engine which he mentions in his "Century of Inventions," was the result of his own ingenuity. The advantages of steam, as an impelling power, being thus known, the ingenious Captain Savary invented an engine which raised water by the expansion and condensation of steam. Several engines of this construction were actually erected in England and France, but they were incapable of raising water from depths which exceeded thirty-five feet. The steam-engine received great improvements from our countrymen Newcomen, Brighton, and Blakey; but it was brought to its present state of perfection by Mr. Watt, of Birmingham, one of the most accomplished engineers of the present age. Hitherto it had been employed merely as a hydraulic machine for draining mines or raising water; but, in consequence of Mr. Watt's improvements, it has long been used as the impelling power of almost every species of machinery. It is a curious circumstance, that the steam-engine was not only invented, but has received all its improvements, in our own country.

GROVE'S VOLTAIC BATTERY.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Mr. W. R. Grove constructed a small battery, consisting of seven liquer glasses, containing the bowls of common tobacco-pipes, the metals zinc and platinum, and the electrotypes—concentrated nitric and dilute muriatic acids. This little apparatus produced effects of decomposition equal to the most powerful batteries of the old construction. Mr. Grove has since altered his battery, by using flat parallelopiped-shaped vessels for the platinum and nitric acid, and uses salt and water in connexion with the zinc. A roughly-constructed battery on this principle, was presented to the British Association; it consisted of an outer case of wood (glazed earthenware is better), seven inches and a half by six and three, separated into four flat compartments by glass divisions, into which were placed four flat porous vessels, measuring, in the interior, seven, two and a half, and three-tenths of an inch, and containing three ounces each by measure. The four pair of metals expose each a surface of ten square inches, and the battery gave, by decomposition, three cubic inches of mixed gases per minute; charcoal points burned brilliantly, and it heated six inches of platina wire one-fiftieth of an inch in diameter. Its action lasted about an hour, without a fresh supply of acid. The cost of this apparatus was stated to be about two guineas. During the action of the battery, the nitric acid, losing successive portions of oxygen, assumes first a yellow, then a green, next a blue, and, finally, becomes aqueous. The hydrogen is evolved from the platina, and the energy lowers.

This form of battery, while it is the most intense, and, therefore, the most valuable for short experiments, is, also, the most short-lived in its action, and is the most expensive in its construction and employment. The great expense of the platina has induced Prof. Bachoffner to modify the construction, so that a maximum effect is produced at a minimum cost. Instead of making the platina equal in surface to the zinc, he takes a slip about an inch broad, and places it inside a circular porous cell, placed in the middle of a cylinder of zinc.

I will now proceed to give directions, whereby any one of ordinary ingenuity, may construct an effective battery at the lowest possible cost:—Suppose our battery is to consist of four three-pint jars; procure four jelly-jars, of the required size, at any chinaware shop; they will cost about 2*d.* each: next get a mahogany box, made three inches deep, and just large enough to contain the jars conveniently. Obtain four porous cells, a little longer than the depth of the jars, at 4½*d.* each; four slips of platina foil, three-fourths of an inch broad, as long as the depth of the porous cells, and as thin as possible, at 30*s.* per ounce, which will cost about 9*d.* each; also eight binding screws, cost 4*s.* The zinc must be the thickest sheet that can be got; four pieces, six inches long and three broad, at 6½*d.* per pound, about 3*s.* Get each piece bent into a roll, about two inches and a half across, by any tinman; they must be amalgamated, by dipping them into sulphuric acid diluted with half its volume of water, and then rubbing them with a cork dipped into mercury; then get four pieces of very thin sheet copper, an inch long, and half-an-inch broad; fold each piece lengthwise, and place one end of one of the platina strips in each, and hammer the copper close, so as to hold the foil firmly; obtain, also, about two pennyworth of stout copper wire. We have now all our materials, and it now remains to put them in their proper places. Set the jelly-jars in the box or tray, affix a binding screw, by the clamp end, to each of the zincs, and place one of each of the latter in each jar, and, also, within each of the rolls, place one of the porous cells; next cut four pieces of copper wire, of a proper length, and bend them so that, when one is placed in the hole of the zinc-binding screw of one jar, it shall project over the porous cell of the next. Affix the other four binding screws, one to each of the foils, by the copper ends before spoken of, and fasten one to each copper wire, so that it shall be inside the porous cell. To the zinc of the first jar will thus be affixed the platina inside the cell of the second; to the zinc of the second, the platina inside the third; to the zinc of the third, the platina inside the fourth: so that there will be a platina at one end of the battery, unconnected with a zinc, and at the other end a zinc, unconnected with a platina. By bringing a wire from the two vacant binding screws of the metals into contact, the circuit is completed; and whatever is placed between the ends of the wires, experiences the effects of galvanism. The wires from these two last metals are called the poles; the platina end by the distinctive name of the anode (being the end at which the fluid leaves the battery); and the zinc end the

cathode, being the end at which the fluid returns.

To put the battery in action, fill each porous cell with strong nitric acid, obtainable at 1*s.* per pound; and outside the porous cell, in the jelly-jar, pour dilute sulphuric acid, composed of one part acid and seven parts water. Sulphuric acid will cost 3*d.* per pound. The acids, porous jars, and binding screws, may be obtained, at the prices named, at Newberry's, practical chemist, 60, Fetter Lane. The zinc, copper, and copper wire, at Foster's tool-warehouse, St. John's Square, Clerkenwell; and the platina at Johnson and Cock's, refiners, 99, Hatton Garden.

I remain yours, &c.,

W. H.

BENEFITS OF MACHINERY.

The blessings which physio-mechanical science has bestowed on society, and the means it has still in store for ameliorating the lot of mankind, have been too little dwelt upon; while, on the other hand, it has been accused of lending itself to the rich capitalists as an instrument for harassing the poor, and of exacting from the operative an accelerated rate of work. It has been said, that the steam-engine now drives the power-looms with such velocity, as to urge on their attendant weavers at the same rapid pace; but that the hand-weaver, not being subjected to this restless agent, can throw his shuttle and move his treadles at his convenience. There is, however, this difference in the two cases—that, in the factory, every member in the loom is so adjusted, that the driving force leaves the attendant nearly nothing at all to do—certainly no muscular fatigue to sustain; while it procures for him good unfailing wages, besides a healthy workshop *gratis*; whereas the non-factory weaver, having everything to execute by muscular exertion, finds the labour irksome, makes, in consequence, innumerable short pauses, separately of little account, but great when added together; earns, therefore, proportionally low wages, while he loses his health by poor diet and the dampness of his hovel. The constant aim and effect of scientific improvements in manufactures, are philanthropic; as they tend to relieve the workman from niceties of adjustment, which exhaust his mind and fatigue his eyes, or from painful repetition of efforts which distort or wear out his frame. At every step of each manufacturing process described in this volume, the humanity of science will be manifest. New illustrations of this truth appear almost every day, of which a remarkable one has just come to my knowledge. In the woollen-cloth trade, there is a process between carding and spinning the wool, called *slubbing*, which converts the spongy rolls turned off from the cards, into a continuous length of fine porous cord. Now, though carding and spinning lie within the domain of automatic science, yet slubbing is a handicraft operation, depending on the skill of the slubber, and participating, therefore, in all his irregularities. If he be a steady temperate man, he will conduct his business regularly, without needing to harass his juvenile assistants, who join together the series of card rolls, and thus feed his machine; but if he be addicted to liquor and passionate, he has it in his power to exercise a fearful despotism over the young piecemers, in violation of the proprietor's benevolent regulations. This class of operatives, who, though inmates of factories, are not, properly speaking, factory workers, being independent of the moving power, have been the principal source of the obloquy so unsparingly cast on the cotton and other factories, in which no such capricious practices or cruelties exist. The wool-slubber, when behind-hand with his work, after a visit to the beer-shop, resumes his work with violence, and drives his machine at a speed beyond the power of the piecemers to accompany; and if he finds them deficient in the best point, he does not hesitate to lift up the long wooden rod from his slubbing frame, called a billy-roller, and beat them unmercifully. I rejoice to find, that science now promises to rescue this branch of the business from handicraft caprice, and to place it, like the rest, under the safeguard of automatic mechanism.—*Dr. Ure's Philosophy of Manufactures.*

MUTUAL-INSTRUCTION SOCIETY.

To the Editor of the Penny Mechanic and Chemist.

Sir,—It appears strange that there is not to be found, at the West End, any society of young men, such as are formed in other parts of town; I mean young men's mutual-improvement societies. Surely there are plenty of young men, whose business detains them at the counter or desk till eight or nine o'clock in the evening, who would gladly avail themselves of the opportunity of obtaining knowledge in such an attractive form. I have been in-

duced, sir, to address you on the subject; judging that many young men, fond of scientific pursuits, read your entertaining Magazine, and that a notice of this from you, may catch the eye of such. It is proposed to form a society on the usual principles, having a lecture and discussion each week. Any persons anxious for the formation of one, who will address to "J. Y. B., Mr. Poulson's, 51, Mortimer Street," will find those who will joyfully co-operate with them.

I remain yours, &c.,

J. Y. B.

P.S. The neighbourhood proposed, is somewhere to the south of Oxford Street, between Regent Circus and the top. Monthly subscription, one shilling.

THE CHEMIST.

ALUMEN.

The alum of commerce, and that presented for medicinal purposes, is afforded by ores which are dug out of the earth for this purpose, and manufactured by first decomposing the ore, then lixiviating it, evaporating the lixiviums, and then crystallizing the alum, which affects the form of tetrahedral pyramids, applied to each other, base to base; sometimes the angles are truncated.

The base of alumen is aluminous earth, from which it derives its name. It constitutes the lower strata of mountains and plains. It arrests the waters, and causes them to rise in springs to the surface of the earth. It enters into the natural composition of the schistus, and all those stones and earths called argillaceous—such as potter's clay, Fuller's earth, lepidolite, mica, corundum, &c. Hitherto it has not been found pure anywhere, except in the garden of the public schools at Halle, in Germany.

Alumine is white and soft to the touch. It is insipid, adheres to the tongue, and occasions a sense of dryness in the mouth. When moistened with a small quantity of water, it forms a tenacious, ductile, kneadable paste. When heated to redness, it shrinks considerably in bulk, and at last becomes so hard as to strike fire with flint. After being ignited, it is no longer capable of being kneaded with water into a ductile mass. It recovers, however, this property, by solution in an acid and precipitation. Alkalies dissolve it in the humid way, and form compounds decomposable by acids. It possesses a powerful attraction for lime. The most intense heat of our furnaces is not able to melt it, but it becomes fusible when lime is added. Lavoisier has proved, that it is capable of entering into a kind of fusion, like paste, by the action of oxygen gas; it then cuts glass and resists the file. It absorbs water and carbonic acid from the atmosphere. By its mixture with water and silex, it acquires great solidity. It does not unite with any combustible substance, but becomes fused into coloured frits with metallic oxides. Its specific gravity is 2. It is employed in a multitude of arts.

Method of obtaining Pure Alumine.—Take any quantity of alum of commerce, dissolve it in six parts of boiling distilled water, and add to this solution, when cold, liquid ammonia, till no farther precipitate ensues; then heat the whole nearly to the boiling point for a few minutes, and transfer it on a filter. In proportion as the fluid passes off, pour more water over the precipitate, until it passes tasteless. Let the precipitate obtained, while yet in a pasty state, be transferred into glass or Wedgwood's basin, and add to it muriatic acid, in small quantities at a time, until the whole is dissolved. Then evaporate the solution, till a drop of it, when suffered to cool on a plate of glass, yields minute crystals: on letting it now cool, crystals of alum will be deposited. Remove these crystals, by decanting the fluid, and renew the evaporation, until, on farther cooling, no more crystals are formed. Nothing now but pure alumine remains in the solution; the fluid may, therefore, be decomposed, by adding to it, gradually, liquid ammonia, till no farther precipitate ensues. The precipitate thus obtained, when well washed and dried, is pure alumine.

The process recommended in general by systematic writers, for obtaining alumine, differs from this; it consists in decomposing a solution of alum of commerce by an excess of a carbonated alkali, washing the obtained precipitate, and exposing it to a sufficient heat to drive off the carbonic acid. This method, however, is imperfect; for if the alumine, thus obtained, be heated with charcoal, and a diluted acid is added to the mixture, sulphurated hydrogen gas will be liberated. It adheres to the tongue, and emits a peculiar odour when breathed upon; sure signs that it is not pure.

It must be obvious, that alumine cannot be obtained absolutely pure in this manner; for alum is a triple compound, consisting of alumine, potash, and sulphuric acid in excess. When this excess of acid is saturated, by adding to the solu-

tion an alkali, or even pure alumine, a highly insoluble salt (sulphate of alumine) is produced, differing from alum only in the proportion of its base. When we, therefore, gradually add to a solution of alum, a carbonated alkali, the first effect of the alkali is, to saturate the excess of the sulphuric acid, and the precipitate consists principally of the salt which is insoluble in water. A farther quantity of the alkali effects instantly a decomposition of part of the salt, which, in proportion as it takes place, becomes mixed with the alumine; and it is thus covered from the farther action of the alkali. This being the case, it is obvious, that no subsequent washing can do more than separate the sulphate of potash, and, therefore, the residuum, instead of being pure alumine, contains also a variable proportion of true sulphate of alumine; the sulphuric acid of which, becoming decomposed on heating it in contact with charcoal, accounts for the sulphurated hydrogen gas produced by the affusion of an acid. With the acids, it is known to form more than twenty species of neutral salts.

CAUSE OF STEEL TURNING BLUE.

To the Editor of the Penny Mechanic and Chemist.

Sir,—While perusing the last Number of your useful Magazine, I was rather surprised at your correspondent, "Mr. Reeves," asserting, and endeavouring to prove, my statement respecting the cause of the blue on steel, to be erroneous. In my opinion, "Mr. Reeves should have reflected a little," before he re-advanced the theory of "oxygen being attracted from the atmosphere," and should have considered whether he (Mr. R.) was a competent umpire to decide between the "opinion of chemists" and the result of my own experience.

Instead of "Mr. Reeves" proving the fallacy of my statement, he advances two tests—viz. the tincture of galls and ferrocyanide of potassium, as well as the weak acids, in favour of it, respecting oxygen being the cause of the blue. If I assert that the oxygen contained in the atmosphere is not the cause of the blue, I do not assert that the oxygen in the steel is not the cause of the like result. I would ask "Mr. Reeves," upon what authority he states, that, "if steel be heated when not in contact with oxygen, no blue colour is produced?" I have blued steel in an exhausted receiver of an air-pump (which I constructed for the express purpose of ascertaining the cause of the blue), and have specimens by me which I will produce at any time. If my statement respecting the cause of the blue is incorrect, I would propose another query to him (Mr. R.)—viz. when steel is entirely excluded from the atmosphere, and caloric applied to it, where does it obtain its oxygen from to cause the blue?

Now, sir, your "tyro in chemistry" begs for a few lines more. I cannot imagine how "Mr. Reeves" could suppose, that, when I stated but one gas (hydrogen), I should have intended four, the three gases of the atmosphere—the oxygen, nitrogen, and carbonic acid gases—and the before-mentioned hydrogen gas, for the steel to be immersed in. But in reference to a jar or gasometer of pure hydrogen, "Mr. Reeves" cannot deny, or endeavour to falsify my statement, of the explosive or expansive properties of that gas when heated. "Mr. Reeves" will find, that when hydrogen is heated to 560° Fah. (which is the temperature at which steel changes blue), it will be rarified to such an immense pressure, as to require exceedingly strong apparatus to prevent its bursting.

I remain yours respectfully,
T. R. Bilbrough.

A HOLLOW FLAME.

To the Editor of the Penny Mechanic and Chemist.

Sir,—In answer to the very incomprehensible letter that appeared in your last week's Journal, respecting my article on "Hollow Flame," your correspondent, "A. W.," in one part of his letter writes, that "a hollow flame may be made by the means shown by your correspondent." He then states that "Dr. Murray gives almost the same experiment;" at the same time observing, that "he disagrees with the very learned authority, as well as your correspondents." At all events it must be admitted, that "A. W." contradicts himself; first, by disagreeing with me, and, at the end of his letter, admitting the same to give proof to your readers, that the flame of spirits is hollow. (See my experiment on the subject, p. 74, in which I give an easy experiment illustrating my observation). I believe with the "learned authority," Dr. Murray, that flame generally is hollow, but not sufficiently so to be proved by my experiment, or any other such simple method. I see no reason that anything I have be-

fore stated should be doubted, when it may be proved with so little trouble.

I remain yours, &c.,

T. Fuller, Jun.

MISCELLANEA.

Curious Clock at Strasburgh.—At Strasburgh there is a clock, of all others the most famous, invented by Coniadius Dasipodius, in the year 1571. Before the clock stands a globe on the ground, showing the motions of the heavens, stars, and planets. The heavens are carried about by the first mover in twenty-hours. Saturn, by his proper motion, is carried about in thirty years; Jupiter in twelve; Mars in two; the Sun, Mercury, and Venus, in one year; and the Moon in one month. In the clock itself there are two tables, on the right and left hand, showing the eclipses of the Sun and Moon, from the year 1573 to the year 1624. The third table in the middle is divided into three parts. In the first part, the statues of Apollo and Diana show the course of the year, and the day thereof, being carried about in one year. The second part shows the year of our Lord and the equinoctial days, the hours of each day, the minutes of each hour, Easter day, and all other feasts, and the dominical letter. The third part hath the geographical description of all Germany, and particularly of Strasburgh, and the names of the inventer and all the workmen. In the middle frame of the clock is an astrolabe, showing the sign in which each planet is every day; and there are the statues of the seven planets, upon a round piece of iron, lying flat; so that every day the planet that rules the day, comes forth, the rest being hid within the frames, till they come out, by course, at their day; as the sun upon Sunday, and so for all the week. And there is, also, a terrestrial globe, which shows the quarter, the half-hour, and the minutes. There is, also, the skull of a dead man, and statues of two boys, whereof one turns the hour-glass when the clock hath struck; the other puts forth the rod in his hand at each stroke of the clock. Moreover, there are the statues of Spring, Summer, Autumn, and Winter, and many observations of the Moon. In the upper part of the clock are four old men's statues, which strike the quarters of the hour; the statue of Death comes out, at each quarter, to strike, but is driven back by the statue of Christ, with a spear in his hand, for three quarters; but in the fourth quarter, that of Christ goes back, and that of Death strikes the hour with a bone in his hand, and then the chimes sound. On the top of the clock is an image of a cock, which twice a-day crows aloud, and claps his wings. This clock is decked, beside, with many rare pictures; and, being on the inside of the church, carries another frame to the outside of the wall, wherein the hours of the Sun, the courses of the Moon, the length of the day, and such other things, are set out with great art.—*Morrison's Itinerary.*

Cotton-Spinning Machinery.—Till the year 1776, cotton spinning was performed by the hand spinning-wheel, when Hargrave, an ingenious mechanic, near Blackburn, made a spinning jenny with eight spindles; and, having permitted one Peel, of that place, to view it as a curiosity, under an engagement of secrecy, Peel availed himself of Hargrave's invention; while Hargrave, on the report of the invention, had his cottage pulled down by a mob. Hargrave was obliged to remove to Nottingham, where he assisted Arkwright, but died in poverty. His last surviving daughter, the very one who worked the first jenny, was living in 1829 at Manchester, on a charitable stipend of three shillings per week; though the cotton manufacture, consequent on this invention, had yielded to Britain 1000 millions sterling. Hargrave also erected the first carding machine with cylinders. Arkwright's machine for spinning by water, was an extension of the principle of Hargrave; and he also applied a large and small roller to expand the thread, and for this ingenious contrivance took out a patent in 1769. At first he worked his machinery by horses, but in 1791 he built a mill on the stream of the Derwent, at Cromford. In 1772 his patent was contested, and cancelled in 1785, on the evidence of the widow and sons of Hargrave, who appeared to have been the inventer of the crank, so essential to the carding process.

To Prevent Insects from Destroying Plants, &c.—If garden or agricultural seeds, previously to being sown, are soaked in a solution of aloes (say a quarter of an ounce to a pint of boiling water), it will effectually prevent birds, mice, or insects, devouring them. Some species of flowers, particularly the heartease, get much disfigured by being gnawed by slugs; a very small portion of aloes in powder, or a little of the solution sprinkled over the plant, will turn their feasting to fasting. I have tried the plan for some years past, and found it to be very successful. I have no doubt, but that, if wheat, barley, beans, &c., were similarly prepared, thousands

of bushels would be preserved from the ravages of birds, &c. There is a species of insect which generally goes by the cognomen of the black army, which invades and riots among the young turnip plants, just as they appear above ground, and is annually the cause of the loss of thousands of acres. If a plan could be adopted to sprinkle the young plants with the solution before mentioned, they would immediately beat a retreat. I have tried this repeatedly on a small scale, and uniformly found it successful. The Cape aloe, which is the cheapest, will do as well as any.

Economy of Wheaten Flour.—It has been found, that when economy of wheaten flour is desirable, that 1 lb. of rice goes as far as 8 lbs. of flour; and that 2 lbs. of potatoes are equal to 1 lb. of flour, and equal to 4 lbs. of turnips or carrots. Five pounds of boiled potatoes, mixed with 20 lbs. of flour, make as good bread as can be eaten. Bran boiled in the water used for kneading dough, greatly increases the weight.

Ingenuity of the Chinese.—In toys and fine mechanism, the Chinese are highly ingenious, and imitate with readiness the most curious productions of European workmen. They make little or no use of machinery; it is constantly discouraged by the government, as interfering with the subsistence of the people. The arts of Europe, which have been carried to perfection in the last century, were as perfect in China 1000 years ago, as in Europe now. The common people were clothed in silk, while the people of Europe wore woollen cloths as coarse as blankets. The Chinese ladies enjoyed a superb toilet and costly trinkets, while wooden skewers were used instead of pins; and when oats and turnips were first grown in Europe, China enjoyed luxuries of our improved horticulture. If Europe has excelled them, it has been chiefly by imitating them and the Hindoos. The Chinese appear, beyond doubt, to have made many of the important inventions claimed, in the dark ages, by sundry Europeans. They invented the cycle of sixty years, before the use of the epoch of the Olympic games. They printed from blocks as early as the tenth century; they used the magnet before the year 900; they have used gunpowder for fireworks, as long since as the Christian era, and make it exactly in our proportions; they have had original spectacles, of crystal heads, from time immemorial, also concave reflectors, or varieties all their own; they invented paper in the first century, and their language proves, that the written character was borrowed, and not even improved, by the Phœnicians. Many of the Chinese arts cannot be imitated even to this day; much as we, on the contrary, excel them in particular inventions.—*Hall.*

Production of Light.—If lime powder, from which the carbonic acid has been expelled, be exposed to the intense heat of the union of oxygen and hydrogen at the poles of a voltaic battery, or at the current of a blowpipe, it is converted into calcium, and, during the combustion, gives out so much light, that a small piece or pea of it may be used in light-houses, and in microscopes, instead of solar light; and, for this last purpose, chalk, exposed to the hydro-oxygen blowpipe, answers equally well.

Minute Structure of Vegetables.—In charcoal, the microscope discriminates vessels or tubes, of which there must be millions in a square inch. In a square inch of oak or gourd, there are twelve millions of such tubes or cells. In stems of herbs, the small bunches of vessels consist of from 100 to 500. Through these tubes the fluids ascend in spring, before the formation of buds and leaves; they are larger as they recede from the centre. The pores in leaves are, per square inch, 1,3000 in the vine; 64,000 in the silex, and 160,000 in the hydrangea and syringa. It is the minute structure which enables vegetables to secrete, from dead matter, those corpuscles which constitute the substance of all living matter, as a new order of subsistence in all the forms of organized beings.

A Curious Fact in Food and Manure.—It has been before stated, that every part of a plant contains nitrogen as well as carbon; but, as an invariable rule, the seed of all plants contains a much larger quantity of nitrogen than the leaves and stalks, and a less quantity of carbon; and inversely, the leaves and stalks contain a much greater quantity of carbon, and a less quantity of nitrogen. Now, when a horse is fed on grass, his food consists almost entirely of carbon; and the result is, that, when he has a sufficient supply, he gets fat—that is, that particles of oily, fatty matter, are deposited on the muscles under the skin; but, as it is well known, a horse in this condition is quite unequal to any work, and the least exertion reduces his bulk. But when the same horse, under other circumstances, is fed on corn, his food consists principally of nitrogen; and although he may never, under this keep, get as fat as under the other, still the increase he does acquire

will be pure muscle, or, as it is technically called, sound flesh; and on this keep he can perform infinitely more work, with less fatigue, than on food containing no nitrogen. A more complete instance could not be adduced, to show that animals, as well as plants, can only assimilate that food which is presented them: in the first case, carbonaceous matters being the food of the horse, carbon is deposited in the shape of fat; in the latter, when more nitrogen enters into the composition of his food, the deposits of muscle preponderate. So it is with wheat. With a manure that supplies only carbonaceous matter, starch is the result. With a manure containing nitrogen, gluten is formed; both cases being completely analogous, and affording unerring proof of one single and uniform law.—*Book of the Farm.*

Absorption of Metals by Plants.—Metals are absorbed or secreted by plants:—Quinine and coffee contain copper; oak, iron; and vines, pines, and figs, manganese.

A Dredging Machine raises in its buckets, in four hours of each tide, 960 tons of gravel per day; or, on a clay bottom, about half that astonishing quantity.

INSTITUTIONS.

LECTURES DURING THE WEEK.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, March 31, William Ball, Esq., on the Comic Literature of the Kingdom. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, March 28, Quarterly Meeting. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, March 31 E. W. Elton, Esq., on the Genius of Shakspeare. At eight o'clock.

Clerkenwell and Pentonville Teetotal Youths' Mutual Instruction Society, at Eagle Court Chapel, West Smithfield.—Tuesday, March 29, Mr. Mee, on Geology. At eight o'clock.

QUERIES.

The best cement for joining broken glass vessels. [See No. 52, p. 415.] The separation of sulphate of baryta from a fluid containing it, is much facilitated by the addition of nitric acid; can any of your correspondents give me a reason or this? T. PEN.

What is the number of teeth in each of the five wheels used in Pain's pedometer, and the ize each wheel should be? J. E.

How to reblue blue spectacles? Where can I get the aura cyanide of potassium, ready prepared for electro-gilding, and the price? F. T. L.

How can I contrive a fountain to act in a globe where gold fish are kept; or where can I buy one at a cheap rate? G. W.

"An Amateur" will be glad if "G. S., Jun.," can inform him what are the usual stops in an organ limited to four or six in number; also, what those stops are generally composed of—wood or metal pipes—by what scale they are tuned, and where some metal pipes could be obtained cheap, new or second hand; also, if he could illustrate farther how the crank acts to draw out the stops, as the writer does not perceive, from his first description, how the proper motion is communicated.

Which kind of telescope is best for very distinct observations of about fifteen miles distance, not requiring portability? One of your correspondents, some time ago, stated he could improve them by a system of his own; his address will oblige. Also how to make a machine that will register the miles travelled by a fourteen-feet chaise wheel? Why are reflecting telescopes not more generally used? A. C. R.

ANSWERS TO QUERIES.

"J. E." is informed, that a person has a good silver pedometer for sale, cheap; which he can see by applying at No. 51, Long Acre. C. P.

Grove's Galvanic Battery.—It consists of six jelly-pots, in each of which (reset within side) is a cylinder of zinc, without a bottom; next is a porous cylinder, made of the same shape as the jelly-pot, but smaller; inside of this is a piece of platina. The electrotypes made use of, are concentrated nitric acid and dilute hydrochloric acid (muriatic acid.) In the outer part of this arrangement, the dilute hydrochloric acid is placed, while the inner vessel is filled with the concentrated nitric acid. The action of the battery is very powerful for an hour or so, when the nitric acid becomes exhausted, and must be renewed. A very great inconvenience I have experienced with this battery, resulting from the very noxious fumes of nitrous gas which arise from it while in action. The best places to buy the materials, are Palmer's, Newgate Street; Knight's, Foster Lane; Dymond's, Holborn Bars; Newbery's, Fetter Lane, Holborn: Poole, Wardour Street, Soho; Ward's, Bishopsgate Street. Should "J. Fitzpatrick" wish any more directions, I shall feel great pleasure in assisting him.

To make an Electrical Machine.—1st. The cylinder of glass is from eight inches in diameter, and twelve in length, with a cap of brass or wood at each end, to turn in a frame of baked wood, consisting of two upright pillars, dovetailed to a flat piece of wood for the bottom, grooves being let in the pillars near the top, so that the caps from the cylinder may rest therein. 2ndly. A handle of brass or wood, to turn the cylinder. 3rdly. The rubber. A pillar of glass, or a piece of hooping; the same as smiths use for bell-hanging, which, being cemented in a piece of hard wood, is made to screw to the bottom of the machine. On the pillar or hooping is a cushion; the back part is wood, the front being stuffed with hair, and covered over with soft leather, to which is attached a piece of silk. The cushion is made

to press hard against the glass cylinder, being previously rubbed with amalgam. 4thly. The conductor; it is of a cylindrical shape, from twelve to fourteen inches long, and eight inches in diameter, made of tin; through which is passed a brass wire, being forked at one end, the other having a brass ball attached to its end. The conductor has a groove underneath, to admit a glass pillar, cemented to a piece of wood, for a stand. 5thly. The Leyden jar consists of a wide-necked jar of glass, coated three parts of the way up, inside and out, and having a lid of baked wood to fit the neck; through which passes a brass wire, having a brass knob at the top, the bottom having a chain attached to it, touching the inside of the jar. 6thly. The discharging rod. Take four inches of brass hooping, a quarter of an inch in diameter; to one end solder a brass wire, having a knob to the end, the other end being left to admit of a glass handle. The machine being complete, it requires to be kept well cleaned.

W. Hopkinson.

The Affinity of Oxygen for Lead is such, that it cannot be overcome by application of heat alone, unless something possessed of greater affinity for oxygen be presented to it. Therefore, if carbon (charcoal, tallow, or oil) be mixed with the lead ashes, and heat applied, the oxygen will unite with the carbon, and the metal will be set free.

"P. T." The beats of a common seconds-clock per hour, are 3600, and 17,280 of a common watch; but seconds-watches beat 18,000 times, or five per second.

Ingredients for Colouring Glass.—Oxide of cobalt tinges glass green; oxide of iron or copper, green; of manganese, violet; of iron and copper, red; of gold, purple; of silver, yellow, and of arsenic and zinc, white.

The Cause of Hats turning Rusty at the Seaside, is owing to the muriatic acid from the sea disturbing the gallic acid in the black dye?

Y. Z.

To obtain Alumina.—The simplest way to obtain alumina, is to dissolve it in about twenty parts of water, and add ammonia until it is nearly saturated, when a bulky white precipitate will fall down. When washed with water, it will be pure alumina.

I cannot understand why "B. S. M." should not comprehend the directions in question. Whatever is placed at the end of the wire opposite to the zinc wire, if metallic, receives a deposit, which deposit, when taken off, will present an impression of the surface deposited on. If that surface has raised lines, those lines will be depressed below the surface in the copy. In order to obtain a correct fac-simile of a sixpence, for instance, we should first take a mould or impression of it in copper, by means of the electrotype, and then place the mould, so obtained, again in the apparatus; and the deposit, when removed from the mould, would, if care be taken, present a perfect fac-simile of the original. If "B. S. M." were to make a few experiments himself, it would give him all the information necessary.

I should recommend "R. M. O." to obtain Walker on "Electrotype Manipulation," in two parts, price 1*s.* each, and "A Manual of Electricity," by Dr. Lardner," in two volumes, price 6*s.* each.

"A. C. R." Wooden vessels for electrotyping should be coated inside with electrical cement, composed of five parts resin, one bees' wax, and one of red ochre. Melt in a pipkin, and, having previously warmed the wood, apply the cement while hot.

W. H.

According to the experiments of Lavoisier and others, the quantity of carbonic acid expired during twenty-four hours, by a man in good health, amounts to more than 15,000 cubic inches, or about 8600 grains. The watery vapour given off during the same time, is nearly 800 grains.

Red Lead is obtained by the exposure of litharge to the action of long-continued heat and a current of air. It consists of four equivalents of lead and three of oxygen.

Metallic Lead may be extracted from its ashes, by mixing them with one-third of their weight of powdered charcoal; placing the mixture in a crucible, and exposing it, for about twenty minutes, to a red heat. It is well to stir it occasionally, in order to unite the smaller particles of the metal. In this process, the carbon of the charcoal unites with the oxygen of the ashes, and the lead is set at liberty.

"A. S." will find abundant information on the subject of coloured glass, in Ure's "Dictionary of the Arts and Manufactures." It would require too great a space to treat it as it deserves.

T. Pen.

TO CORRESPONDENTS.

S. Johnson.—*We are sorry to say, that there is no means of removing the grease spots, so that the paper can be kept quite clean.*

The best test for gold, is strong nitric acid, which should be just dropped on the article. If there be the slightest tinge of green, the gold is adulterated; but if the acid produce no effect, the gold is pure.

C. P.—*The quickest way to make rose water, is, to dissolve six drops of otto of roses, in half-an-ounce of spirits of wine; add to this, half-a-pint of distilled water.*

W. Courtney.—*We have received communications from two correspondents, who have each an electrical machine for sale. He may have their addresses, with particulars, by applying at the* Penny Mechanic *Office, No.* 1, *Long Lane.*

J. D. L.—*To use French polish, roll a piece of flannel very tight, so as to present a smooth surface, and, wetting it with the polish, keep constantly rubbing it into the wood until the polish is produced, which will sometimes take two or three days. A little olive oil should be occasionally dropped on the flannel.*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

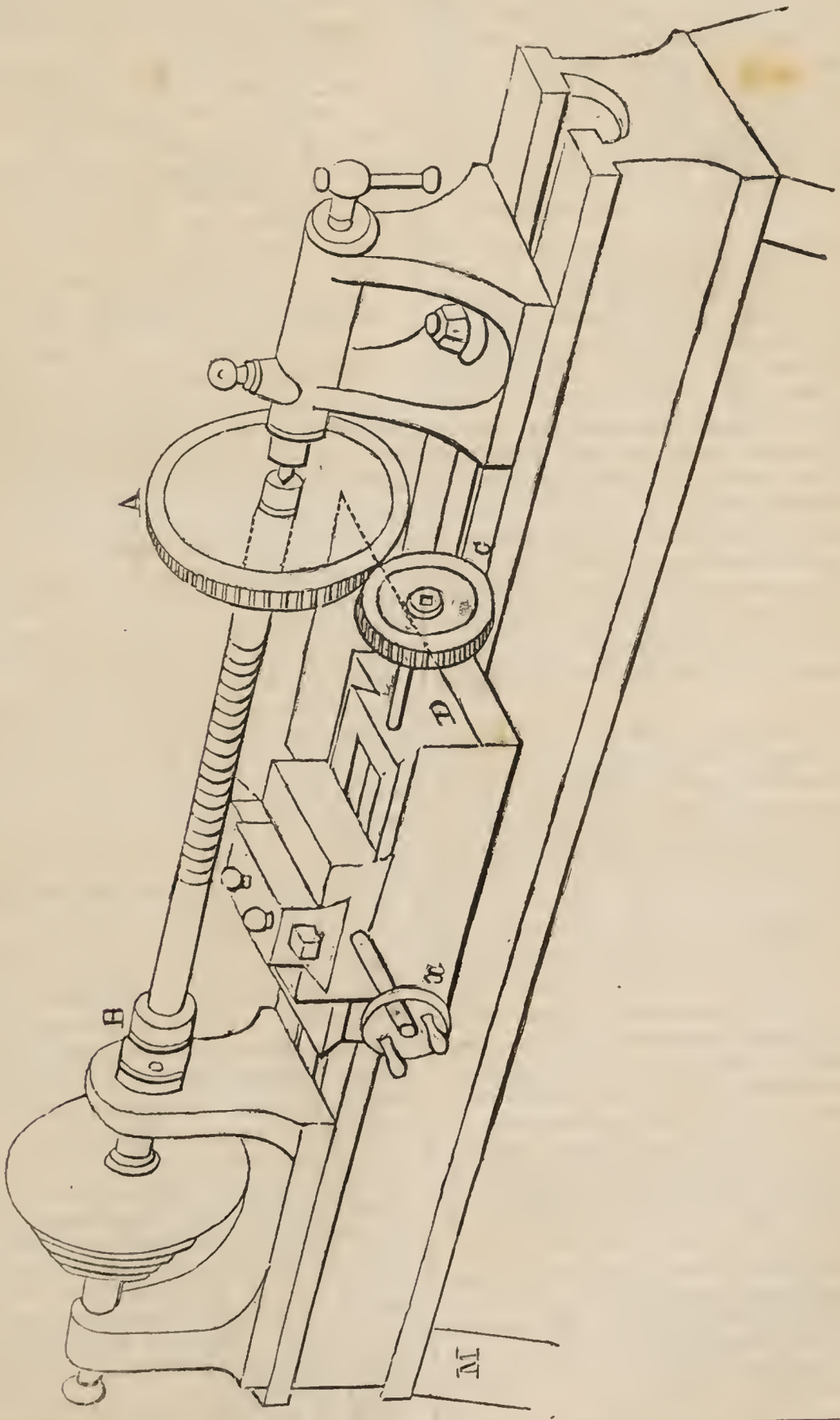
AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 75, THIRD SERIES. | SATURDAY, APRIL 2, 1842. | No. 323, OLD SERIES.

CUTTING SCREWS IN THE LATHE.

FIG. 6.



Vol. VIII.—No. 16.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ON CUTTING SCREWS IN THE LATHE.

No. III.

(See Engraving, front page.)

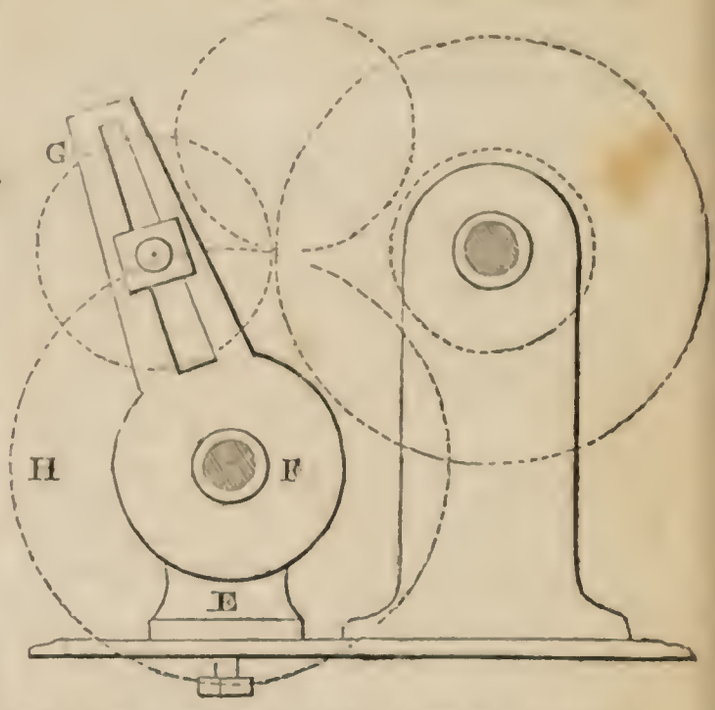
10. If a wheel, A, fig. 6, be fixed on the nose of the mandrel, H, of the lathe, and be so arranged as to gear with another wheel, C, similarly fixed to the end of the main screw, D, of the slide-rest; and if continuous circular motion be communicated to the mandrel, it is manifest that this motion will be transferred, by means of the wheels, A and C, to the carriage of the rest; and, consequently, a screw-tool, properly attached thereto, will receive direct rectilinear motion, and thus trace the spiral thread of a screw on the exterior of any revolving cylinder opposed to its action.*

17. The relative proportions of the wheels, A and C, determine the pitch of the screw to be cut, compared with the pitch of the screw, D, of the slide-rest; thus, if the wheels, A and C, are of equal diameter, we shall produce a screw of the same pitch as that of the screw, D; but if A be larger than C—suppose in the proportion of two to one—then will the pitch of the work be just twice as wide as that of the screw, D; and if these proportions were reversed, the larger wheel being on the main screw of the slide-rest, and the smaller on the mandrel of the lathe, then would a screw twice as fine, or, in other words, one-half the width of the pitch of D, be cut.

18. It is manifest, that as the wheels, A and C, revolve in opposite directions, the thread of the screw produced, will be the reverse of that of the main screw of the slide-rest; so that we shall invariably have a right-hand thread on the one, and a left-hand thread on the other, or the contrary, according to the nature of the screw, D, which, in this case, answers the purpose of a guide or regulating screw.

19. This difficulty is easily removed, by introducing an intermediate wheel between A and C, so as to gear with both. Many ingenious plans have been suggested for working this intermediate wheel; that by the late Henry Maudslay being both simple and convenient in its application, we shall endeavour to explain:—Fig. 7 exhibits a bracket, which may be secured to the bed of the lathe by suitable screws; E is a support

Fig. 7.



fixed by a screw, and carrying a small cylindrical stud or arbor, F; an arm, G, is adjusted on this arbor in such a way, as to have a free angular movement around its centre; this arm has a groove nearly its entire length, so as to allow the axis of the intermediate wheel to be placed in any position, and at any required height. By means of these two movements, the intermediate wheel may be so arranged, as to gear with, or connect together, wheels of almost any dimensions, as shown by the dotted circles, that marked H, representing the wheel on the slide-rest screw. The arbor, F, is so contrived, as to receive, occasionally, one end of an axis, the other extremity of which is formed into a tube, and fits the square of the main-screw of the slide-rest, and thus permits its removal to any part of the bed of the lathe, without deranging or otherwise interfering with the wheel movement.

20. By this, or a similar combination of wheels,* we may obtain every description of screw, due regard being had to the proportions of the wheels, A and C, which, as we have already observed, determine the pitch of the work.†

* It is immaterial whether the rectilinear motion be communicated to the carriage of the slide-rest, by means of a wheel affixed to the mandrel, or to the work in the lathe; the latter is here adopted, as it affords a clearer and better view of the different parts.

* It is stated in a note inserted in "Nouveau Manuel du Tourneur," that the rectilinear movement of the tool-carriage may be obtained without the aid of toothed wheels, but communicated directly from the foot-wheel itself, by continuous motion. The details are not given, consequently we are unable to do more than state the circumstance, and refer to our authority. See vol. ii., p. 249, 250 (3.)

† It is not very easy to calculate exactly

21. The transverse adjusting screw, x, fig. 6, limits the depth of the cut of the chasing tool; and it may not, perhaps, be out of place to remark, that the cut is not made to its full extent at once, but that the operation is progressive, and requires to be repeated several times in succession.

We have already explained a method of cutting screws, by causing the blank to receive a circular and rectilinear motion, while the thread is raised by a pair of fixed dies. This principle is very extensively applied, but has this defect—the pitch of the screw depends on, and is regulated by, a pattern or guide-screw. In the Government Dockyard, at Woolwich, a very ingenious machine is used for cutting a great variety of different screws from one pattern; of which a detailed account, with engravings, has been published by Professor Barlow.*

In this machine, the bolt or cylinder upon which a screw is to be cut, is placed in the lathe; while the die or cutter is fixed in a kind of sliding frame, drawn forward by means of two regulating screws, lying parallel with the bolt. These two screws are turned by two small toothed wheels working into a third, which is keyed on the mandrel or axis of the lathe. By varying the relative dimensions of these wheels, the pitch or inclination of the screw may be altered at pleasure. Thus, if the three wheels are exactly alike, the bolt and the regulating screw will revolve with equal velocity, and the thread produced will be of the same pitch as that of the pattern or regulating screw. If the wheels attached to the screws are smaller than that on the axis of the bolt, they will revolve more rapidly, and the screw produced will be of a wider pitch than the pattern; but if the wheel on the mandrel be the smallest of the set, the screws will revolve slower than the bolt, and a thread of finer pitch will be the result. Thus, by using many different sets of wheels, any description of screw may be obtained. When a double thread is required, the bolt must be turned *half* round, after the first thread is cut, without moving the regulating screws; or for a treble thread, one-*third* round. If we wish to cut an inside screw, all that is requisite is, to fix the tap or cutter to the mandrel of the lathe, and the material to be operated on, in the moving frame or slide-rest.

22. It will occur, we imagine, to every mechanic, that the apparatus just described, is liable to many and serious objections, —such as the inconvenience and loss of time attendant on a frequent change of the toothed wheels, and the risk of inaccuracy arising from any imperfection in the pattern-screws; these, however, may be avoided, by giving to the slide-rest a constant and regular movement.

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS.

(Continued from page 45.)

That the character of steel, even of inferior quality, is greatly improved by careful hammering at a low heat, is, I think, sufficiently proved. The same treatment produces similar results, when applied to the most delicate cutting instruments; and as these, as well as tools for shaping

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the relative number of teeth in the wheels requisite to produce a screw of a given pitch, without resorting to mathematical details; the formula will be best understood by a practical example:—Suppose it be desired to cut a screw which shall have *twenty* threads to the inch, and that the main or guide-screw has *four* threads per inch; or, in technical language, is one-quarter of an inch pitch; the question is, what wheels are requisite to produce this screw? There are several methods of solving the problem, all of which are reducible to one simple principle—the proportion between the guide-screw and that we wish to cut; in this case the one has four, and the other requires twenty threads, per inch; consequently the product of the driving wheels must be to that of the driven, as 4 : 20; or, adopting a fractional expression, $\frac{4}{20}$. We may, if more convenient, break these two numbers into four equivalents—$\frac{4 \cdot 1}{5 \cdot 4}$ = the ratio of the wheels required; and we may multiply these numbers at pleasure, so that we take care to keep the fraction of the same value. But this ratio may be expressed in more general terms, the velocity of the guide-screw being to that of the mandrel, or whatever is attached to it, as 4 : 20, or 1 : 5, which is precisely the same. Let $x\ x'$ represent the first two numbers, and $y\ y'$ the two latter; then as $1 : 5 :: x\ x' : y\ y'$, or $5\ x\ x' = y\ y'$. Now we may assume any two numbers we please for $x\ x'$, the driving wheels, and, multiplying by 5, we obtain the product of $y\ y'$, the driven wheels. Conversely, we may make $y\ y' =$ any two numbers we choose, whose product is $5\ x\ x'$. It is easy to calculate tables to any extent, from the proportion $a : b :: x\ x' : y\ y'$, or $\frac{a}{b} = \frac{x\ x'}{y\ y'}$ or $a\ y\ y' = b\ x\ x'$, where $a : b$ is put for 1 : 5, or 4 : 20, or the ratio of the main screw to the screw to be cut.

* See volume on "Machinery and Manufactures of Great Britain," in "Encyclopædia Metropolitana;" also "Penny Cyclopædia," vol. xxi., page 110.

or turning metal, are almost invariably made of cast steel, we hope to render an essential service to the mechanic, by laying before him a series of practical facts, the produce of many years' experience, and originally made public by Mr. Gill, in that gentleman's scientific works.*

The information we are about to communicate being scattered through *seventeen* octavo volumes, it is difficult to preserve a formal or connected arrangement; the materials, however, may be included under three heads—1st. Working and forging; 2ndly. Hardening, tempering, and annealing; 3rdly. Welding.

"Cast steel should be heated only to a *worm red*, and then subjected to the blows of the forge-hammer; at first moving but slowly, until the sponginess of the metal is overcome, and the steel acquires more cohesion, when the motion of the hammer may be gradually increased; but, above all things, *over-heating* should be carefully avoided, where the good quality of the steel is to be preserved, notwithstanding the greater length of time necessary to be employed in this operation."†

Strictly speaking, this refers to working ingots of cast steel into bars, but is equally applicable to the subsequent treatment; as, indeed, Mr. Gill himself observes, in the paragraph immediately following:—

In working cast steel, it is impossible to use too much precaution; since, although Mr. Horne‡ professes "to restore the properties of over-heated steel, it is a fact, that there is *no remedy* for this evil; and, therefore, when the good quality of the article is a main object, we again repeat, that the steel should be worked with the *least heat possible to forge it*, notwithstanding the additional labour and time expended; and particularly for the harder kinds, where a little carelessness, in this respect, would cause the steel to fly to pieces under the hammer."*

We rarely find any two bars of cast steel, of similar quality; it, therefore, becomes important to adopt some method for proving the bars, so as to be enabled to assort them, according to the indications they exhibit during the process; as we know, that every part of a bar of cast steel will invariably turn out of the same quality as the portion subjected to proof, however dissimilar any number of bars themselves may be, relatively considered.

"To ascertain the quality of cast steel, the bar must be carefully heated at one end, and drawn down to a suitable size for bending, about two inches long, and half-an-inch wide; this must then be heated to the proper degree for hardening—of which we shall treat hereafter—and quenched, leaving the thick portion of the bar still hot, and then be blazed off to a spring temper, and again quenched. The proof is thus effected:—about half-an-inch of the small end of the hardened and tempered portion of the bar is screwed firmly, and in a horizontal position, between the chaps of a strong vice; the operator, then using the bar as a lever, walks round the vice, and gradually bends the steel. If it snap suddenly short on being but little strained, we assume it to be *hard*; if it endure bending a *quarter of a circle*, and then breaks quietly, it is of a *mild* or middling quality; but if it bear to be carried round a full *semicircle*, and then separates like lead, it is a proof of *softness*, and well adapted for springs."†

"In hardening cast steel, the most scrupulous care and attention are absolutely requisite; for, after all the pains bestowed on working the metal, the whole fruits thereof may be lost, *if it be ever so little over-heated in hardening it*; and, therefore, an essay should be made, by hardening a portion of the same bar from which the articles were made, trying first even *below* the presumed hardening heat; and if, on quenching, it should prove soft, heating it again a little *higher*, and so on by degrees, until the proper—that is, the *lowest degree* of heat at which it will harden is ascertained; this should be carefully observed, and all articles, made from the same bar, heated to that limit, and no higher; the article may then be

* These are, 1. "The Technical Repository, containing Practical Information on Subjects connected with Discoveries and Improvements in the Useful Arts." London, 1822-6, 11 vols., 8vo. 2. "The Technological Repository; or, Discoveries and Improvements in the Useful Arts, being a continuation of the Technical Repository." London, 1828-30, 6 vols., 8vo. Both these journals contain a fund of intrinsically valuable and curious matter; both, especially the former, are very scarce; so much so, that it would answer no good purpose merely to refer the reader to the several volumes, without extracting the greater part of the articles: as we doubt whether *half-a-dozen* complete and perfect copies could be found in the London trade. Under these circumstances we have not hesitated to follow, to the letter, Mr. Gill's example; seeing he did not hesitate to appropriate for the public service, whatever he considered calculated to diffuse sound and useful knowledge.

† "Technical Repository," vol. i., p. 137.

‡ "Essays on Iron and Steel," 1773.

* "Technical Repository," vol. i., page 138.

† Idem, vol. i., page 138.

quenched, in ordinary cases, in rain water; but saws or springs should be immersed in suitable hardening liquids." *

It appears questionable whether water is not an improper cooling medium for hardening cast steel; the transition from extreme heat to extreme cold, being too sudden or too violent for this description of steel.

"Various compositions have been recommended for hardening and tempering cast steel, according to the nature of the article. For saws and springs in general, the following is an excellent liquid:—

Spermaceti oil.....	20 gallons
Beef suet, *rendered*	20 lbs.
Neat's foot oil.....	1 gallon
Pitch	1 lb.
Black resin.....	3 lbs.

"The last two articles must be previously melted together, and then added to the other ingredients, when the whole must be heated in a proper iron vessel, with a close cover fitted to it, until all moisture be evaporated, and the composition will take fire on a flaming body being presented to its surface.†

"Cast-steel articles, if *thin or slender*, may be quenched in this composition, in order to harden them, and then be *blazed off* (as the operation is termed) over a clear fire, in order to temper them; but if the articles are *thick*—such as sword blades, &c.—they should previously be hardened by immersion in rain water, and then prepared for tempering, by applying a thin coating of the liquid by the aid of a hard brush, on both sides, and blazed off to the proper temper.

"In some cases it is desirable to impart an unusual degree of hardness to cast-steel tools. The celebrated files made by Raoule, of Paris, possess this property to such an extent, that they will act upon or abrade most of the English files. This peculiarity is supposed to be given by the following composition:—

Mutton suet, *not rendered*, but chopped small	2 lbs.
Hog's lard	2 lbs.
White arsenic, in powder	2 oz.

"These ingredients, being put into an iron vessel, with a cover fitted to it, must be boiled, until a handful of the herb *mouse-ear (hieracium pilosella)*, fresh gathered, and which had been put into the mixture at first, shall become crisp and float on the surface of the liquor—a proof that all moisture is driven off. It is desirable to perform this operation, as well as that of quenching any article in it, under the hood of a smith's forge-hearth, so as to carry off, as much as possible, the noxious arsenical fumes which are disengaged. The operator should also cover his mouth and nostrils, to avoid inhaling the dangerous gas. In using this compound, it must be previously melted; and any thin article may be placed on a red-hot plate of iron, to receive the proper heat,* and then immersed in the liquor. It seems probable, that a small proportion of the arsenic enters into combination with the steel, and thus contributes an extraordinary degree of hardness."†

* "Technical Repository," vol. i., page 139.

† It may, perhaps, be as well to observe, that this state, once ascertained, the lid or cover must be immediately replaced, and the flame extinguished.

HISTORY AND PROGRESS OF THEORETICAL AND PRACTICAL MECHANICS.

No. II.

The success of Galileo in investigating the doctrine of rectilineal motion, induced the illustrious Huygens to turn his attention to curvilineal motion. In his celebrated work, "Horologio Oscillatorio," published in 1673, he has shown, that the velocity of a heavy body descending along any curve, is the same at every instant in the direction of the tangent, as it would have been if it had fallen through a height equal to the corresponding vertical absciss; and, from the application of this principle to the reversed cycloid, with its axis vertical, he discovered the isochronism of the cycloid; or that a heavy body, from whatever part of the cycloid it begins to fall, always arrives at the lower point of the curve in the same space of time. By these discussions, Huygens was gradually led to his beautiful theory of central forces in the circle. This theory may be applied to the motion of a body in any curve, by considering all curves as composed of an infinite number of small arcs of circles of different radii, which Huygens had already done in his theory of evolutes. The theorems of Huygens, concerning the centrifugal force and circular motions, were published without demon-

* "Technical Repository," vol. i., p. 212-13.

† This is a very convenient mode of controlling the heat, and, if carefully watched, we may always avoid over-heating—a common, but fatal error.

strations in 1700. They were first demonstrated by Dr. Keill, at the end of his "Introduction to Natural Philosophy." The demonstrations of Huygens, however, which were more prolix than those of the English philosopher, were afterwards given in his posthumous works.

About this time, the true laws of collision or percussion were separately discovered by Wallis, Huygens, and Sir Christopher Wren, in 1661, without having the least communication with each other. They were transmitted to the Royal Society of London in 1688, and appeared in the 43rd and 46th Nos. of their "Transactions." The rules given by Wallis and Wren, are published in No. 43, pages 864 and 867, and those of Huygens in No. 46, p. 927. The foundations of all their solutions is, that, in the mutual collision of bodies, the absolute quantity of motion of the centre of gravity, is the same after impact as before it, and that, when the bodies are elastic, the respective velocity is the same after as before the shock.

We are indebted, likewise, to Sir Christopher Wren, for an ingenious method of demonstrating the laws of impulsion by experiment. He suspended the impinging bodies by threads of equal length, so that they might touch each other when at rest. When the two bodies were separated from one another, and then allowed to approach by their own gravity, they impinged against each other when they arrived at the positions which they had when at rest, and their velocities were proportional to the chords of the arches through which they had fallen. Their velocities, after impact, were also measured by the chords of the arches through which the stroke had forced them to ascend, and the results of the experiments coincided exactly with the deductions of theory. The laws of percussion were afterwards more fully investigated by Huygens, in his posthumous work "De Motu Corporum ex Percussione," and by Wallis in his "Mechanica," published in 1670.

The attention of philosophers was at this time directed to the two mechanical problems proposed by Mersennus in 1635. The first of these problems was to determine the centre of oscillation in a compound pendulum, and the second, to find the centre of percussion of a single body, or a system of bodies, turning round a fixed axis. The centre of oscillation is that point in a compound pendulum, or a system of bodies moving round a centre, in which, if a small body were placed and made to move round the same centre, it would perform its oscillations in the same time as the system of bodies. The centre of percussion, which is situated in the same point of the system as the centre of oscillation, is that point of a body revolving or vibrating about an axis, which, being struck by an immoveable obstacle, the whole of its motion is destroyed. These two problems were at first discussed by Descartes and Roberval; but the methods which they employed were far from being correct. The first solution of the problem on the centre of oscillation, was given by Huygens. He assumed, as a principle, that if several weights, attached to a pendulum, descended by the force of gravity, and if, at any instant, the bodies were detached from one another, and each descended with the velocity it had acquired by its fall, they would rise to such a height that the centre of gravity of the system in that state, would descend to the same height as that from which the centre of gravity of the pendulum had descended. The solution founded on this principle, which was not derived from the fundamental laws of mechanics, did not, at first, meet with the approbation of philosophers; but it was afterwards demonstrated in the clearest manner, and now forms the principle of the conservation of active forces. The problem of the centre of percussion was not attended with such difficulties. Several incomplete solutions of it were given by different geometers; but it was at last resolved in an accurate and general manner by James Bernouilli, by the principle of the lever.

DESCRIPTIVE GEOLOGY.

(Continued from p. 109.)

NEWER PLIOCENE PERIOD *(continued)*.

Organic Remains.—The most remarkable animal at this time existing on the earth's surface, was the megatherium.

Part of the osseous structure of this gigantic animal, was sent over by Sir Woodbine Parish, from Buenos Ayres, about the year 1831. The bones were found in the river Salado, which runs through the flat alluvial plains (the Pampas) to the south of the city of Buenos Ayres. Their discovery was owing to a succession of unusually dry seasons in the three preceding years, which lowered the water in an extraordinary degree, and exposed part of the pelvis to view, as it stood upright in the bottom of the river.

"If it were allowable to contrast the admeasurements of individual parts of two

animals, in other respects dissimilar, some of those of the megatherium are so singular, that, when compared with those of an elephant of eleven feet in height, the latter seem to sink into absolute insignificance. Of these, the pelvis, femur, and os calcis, afford the most striking examples :—

	Elephant.	Megatherium.
The expansion of the ossa ilia	3 ft. 8 in.	5 ft. 1 in.
Breadth of largest caudal vertebra	0 7	1 9
Circumference of middle of femur	1 0	2 2
Length of os calcis	0 7½	1 5

This animal was closely allied to the ant-eaters and sloths. The skull much resembles that of the sloths, but the rest of the skeleton bears a relationship, partly to the sloths and partly to the ant-eaters. Its tegumentary covering, likewise, seems to have been not unlike that of the ant-eaters and sloths. The whole of its structure is admirably adapted for digging the earth, so as to enable it to obtain the succulent roots, which, in all probability, constituted the principal part of its food. The snout of the animal appears to have terminated in a short proboscis, which must have borne a strong resemblance, in its proportions, to that of the modern tapirs. Its feet were a yard in length, and terminated in most gigantic claws. Its tail was much larger than that of any other beast among extinct or living terrestrial mammalia. When full grown, the megatherium must have been more than fourteen feet long, including the tail, and upwards of eight feet in height. Its entire frame, therefore, was an apparatus of colossal mechanism, adapted exactly to the work it had to do; strong and ponderous, in proportion as this work was heavy, and calculated to be the vehicle of life and enjoyment to a gigantic race of quadrupeds, which, though they have ceased to be counted among the living inhabitants of our planet, have, in their fossil bones, left behind them imperishable monuments of the consummate skill with which they were constructed.

An almost entire skeleton of an adult megatherium was discovered in 1839, on the bank of the Rio de la Matanza, with all the vertebræ of the body, all the ribs, all the teeth, the head, and the legs; in short, with the whole of the bones, except the tail and one foot. It appears, then, that South America must have swarmed with great monsters, like the southern parts of Africa; but now we find only the tapir, guanaco or llama, armadillo, and capybara; mere pigmies, compared to the antecedent races.

The following immediate probable cause of the extinction of this and other gigantic quadrupeds, whose remains are found in America, has been suggested. The southern parts of that great continent are even now subject to long-continued droughts; sometimes lasting for three years in succession, and bringing destruction on the cattle; and, indeed (as has been before observed), the discovery of the remains collected by Sir W. Parish, was owing to a succession of unusually dry seasons. The upright position of most of the twelve or thirteen skeletons found *in situ*, with the ponderous vertebræ and bones of the pelvis, in their natural situation, indicates that the animal must have been bogged in adhesive mud, sufficiently firm to uphold the immense bones after the decomposition of the soft parts. A long-continued drought would naturally have brought these animals from the drained and parched country to the rivers, dwindled, by the continued dry seasons, to a slender stream, running between extensive mud banks, in which these creatures may have been engulphed, in their anxious efforts to reach the water. Mr. Darwin states ("Voyages of the *Adventure* and *Beagle*, between the Years 1826 and 1836"), that he was informed by an eye-witness, that, during the "gran seco," the cattle, in herds of thousands, rushed into the Parana, and, being exhausted by hunger, they were unable to crawl up the muddy banks, and were drowned. Sir W. Parish, in his recent work on Buenos Ayres, published in 1839, says, that in the last great drought, which continued during 1830, 1831, and 1832, it was calculated, that from a million and a half to two millions of animals died. The borders of all the lakes and streamlets in the province, were long afterwards white with their bones.

DECARBONIZING STEEL PLATES.

With regard to decarbonizing steel plates, various methods are used. Mr. Perkins placed them in a close cast-iron box, with sufficient iron filings to cover the plate to the thickness of at least half-an-inch, and exposed them, while thus enclosed, to a white heat, until the steel became decarbonized or converted into very pure soft iron, to a depth equal to about three times the depth of the incision to be made, in executing the intended engraving. The box was then cooled very slowly, being

covered up with fine cinders, to prevent the access of air. The plates are least likely to warp when placed in a vertical position. To harden them, they are exposed for some hours to a red heat, the surface being thickly covered with animal charcoal, formed of burnt leather or bones, and the whole being, as before, enclosed in a cast-iron box. The plate is afterwards cooled in water, but not allowed to remain in the water till quite cold, but taken out as soon as it is cooled to the tempering heat, which is ascertained by careful attention to the sound emitted. The plate should be taken out when at the heat required for tempering to a straw colour, and afterwards lowered, by holding it over a fire until tallow, smeared on its surface, is decomposed by the heat, so that smoke arises from it. It is then again put in water till the sound emitted is rather weaker than before. These operations are repeated till the plate has been three times lowered or softened over the fire, and three times partially hardened by cooling, after which it is finally cooled in water. It is then cleaned off, and again tempered over the fire to a brown, or such other colour as may be needed. Warren's mode of decarbonizing steel plates, was similar to that of Perkins, except that the box was filled with a mixture of iron turnings and pounded oyster shells, instead of simple iron filings; and several plates were laid in the same box, alternating with layers of the decarbonizing mixture. Mr. Hughes, a copper-plate maker, improved this process, by substituting a case of refractory clay for the cast-iron box, by which means he was able to apply a degree of heat that would have melted the iron, and thereby to soften the plates more completely. Each plate required two or more "cementations" to soften it to the required degree; and Warren rectified any accidental warping, by striking the plate with a hammer between these operations. Hughes found it better to perform this operation with a mallet, and to apply that with as little force as possible.

W. H.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 20, Southampton Buildings, Chancery Lane.—Wednesday, April 6, Mr. Henry Buss, on the Physical Influence of Water—Geological—Fossil Evidence of Former Worlds—Hypothesis of Creation—Mutations of Climate. Friday, April 8, G. F. Richardson, Esq., on Geology. At half past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, April 7, William Ball, Esq., on the Comic Literature of the Kingdom. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, April 7, E. W. Elton, Esq., on the Genius of Shakspeare. At eight o'clock.

QUERIES.

Some few years ago, an ingenious mechanic published a mode of cutting right and left-hand screws by means of the same dies; I shall feel particularly obliged to any person who may be able to give me a description of the plan, or refer me to the periodical in which it was originally published. 2. I am about to erect a small forge for experimental purposes, but, before doing so, I wish to know the best plan, materials, &c.? Possibly some of the readers of the PENNY MECHANIC may be in a situation to assist me. 3. The best place to purchase crucibles of the usual description; also muffles, and the probable cost? 4. I am in want of a small rotary steam-engine of, or about, one-horse power; any one having such an engine, in good working order, to dispose of, may find a purchaser, by stating full particulars, price, &c., addressed to me, care of the Editor of the PENNY MECHANIC. A. M.

I should feel greatly obliged if "G. S., Jun.," would tell me where I can buy the proper metal for organ pipes, and about what price for the same. I have seen them made of zinc; and should like to know if the one sounds better than the other? Secondly, I wish to know the dimensions of one note of the dulciana, in wood, as I can make the rest by the scale with which "G. S." has so generously furnished me? Thirdly, I should like to have a scale for the reeds, as I find no difficulty in making them speak, having made them, but without a scale? Fourthly, where is the cheapest place to buy the ivory for keys?

L. V.

1. What is the difference between the Bude and Oxydelion lights? 2. Will the heat of a lamp be sufficient to produce oxygen from manganese? 3. Have any of your correspondents a lamp furnace to dispose of? The argand principle would be preferred. Also, a good water decomposition apparatus? 4. What is the construction of Ibbetson's geometric chuck? I wish to ascertain the points of difference between it and one of my own invention. W. H.

Which is the best work on electro-gilding and plating; also the price? The method of making Pooloo's Chinese cement for mending glass and china? Also, how to plate copper for the Daguerreotype? The best method of making transfer varnish? H. D. WHITTOCK.

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.
A MAGAZINE OF THE ARTS AND SCIENCES.

No. 76, THIRD SERIES. | SATURDAY, APRIL 9, 1842. | No. 324, OLD SERIES.

HAMMOND'S ROTARY ENGINE.

FIG. 1.

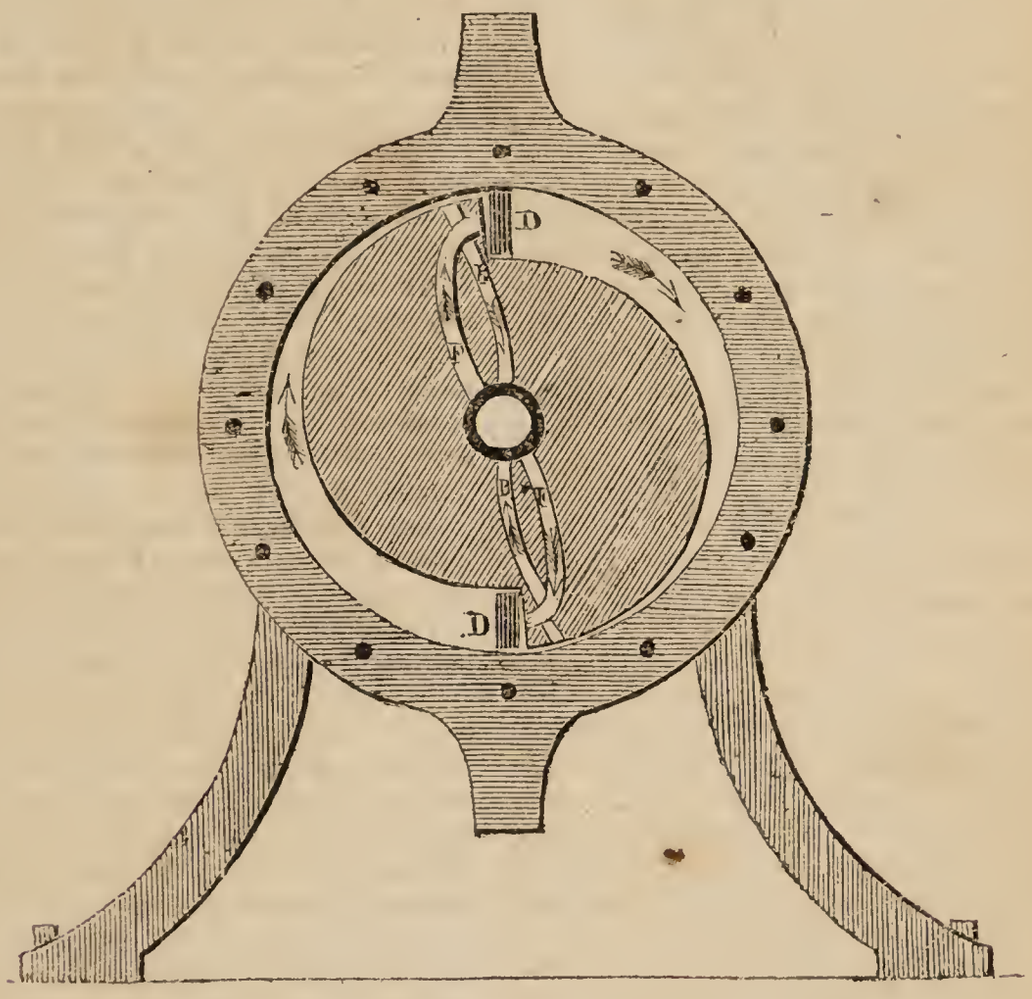
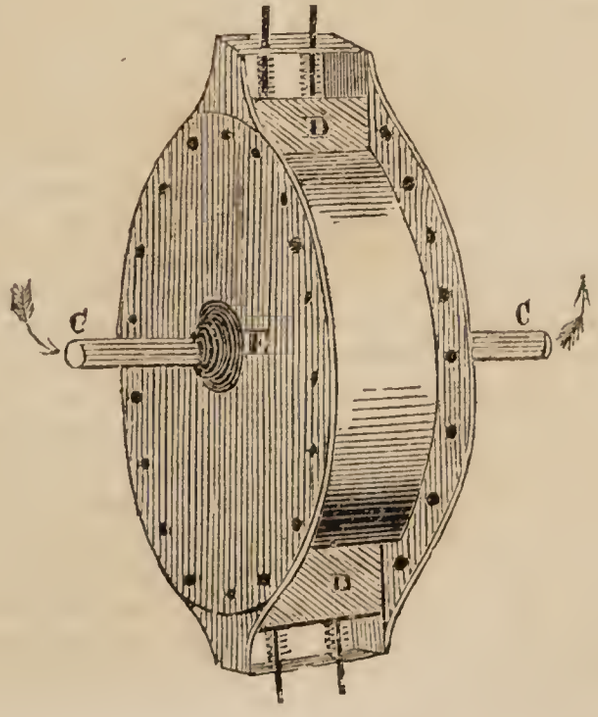


FIG. 2.



Vol. VIII.—No. 17.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ROTARY ENGINE.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—Having made an alteration in my engine, endeavouring to improve it, I send you the drawing for your approval; and if you think it worth again inserting in your valuable work, I shall feel obliged.

I remain yours, &c.,
R. Hammond.

Description of the Engraving.

I now propose letting the steam in at the axle, A, fig. 1, entering the engine two ways at once, F F, similar to "Avery's" plan; and, pressing against the two sliding plates, D D, causes it to revolve, and makes its escape through B B, into the axle, through the other end.

Fig. 2 represents the exterior of the engine, showing the sliding plates, D D, with the springs attached to them; C C is a hollow axle; E, the stuffing-box.

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS.

(Continued from page 125.)

Some articles may be advantageously hardened and tempered at one operation. Springs, especially if made of steel wire or sheet steel, treated in the manner we are about to describe, are found to possess much more elasticity, and are less liable to crack in hardening, than by the usual process.

"The springs are raised to the proper degree of heat, by being placed in a crucible in a suitable furnace; but, instead of being quenched in oil or water, they are plunged into a metallic bath, kept over another furnace, at a heat a little *below* the tempering point, which is ascertained by means of a pyrometer immersed in the bath; and thus they are not cooled *entirely*, as in the ordinary methods—which renders them exceedingly liable to crack in hardening—but only to *the proper tempering degree*. The metal for the bath may be any alloy of tin and lead, which is capable of fusing at, or just below, the proper temperature. The pyrometer consists of a slip of brass and one of steel, rivetted together, which are firmly secured at one end to a metal plate, forming the basis of the instrument; and, at the other, act on the shorter arm of a lever or index, turning on a pivot or centre, and whose longer arm indicates the degree of heat on a graduated arc, formed upon the surface of the metal plate. The instrument should be enclosed in a case, to guard it from being clogged by contact with the fused metal. The heat of the bath may be lowered from time to time, as required, either by adding more metal, or by abating the heat of the furnace.

"This method is similar in principle to that adopted by Mr. Perkins, who prevented his steel blocks from warping or cracking in hardening, by cooling them down *nearly*, but not *entirely*, as is usually done, to the tempering heat. It was, however, discovered and practised in this country many years ago, long previously to Mr. Perkins, by a Mr. James Stone, machinist, of Warwick Street, Golden Square, who, in consequence of the repeated accidents and great loss sustained by hardening and tempering springs in the usual way, was forced, from necessity, to adopt a better; and was so fortunate as to discover the process already described. It should be mentioned, that the springs are finally quenched in oil, and then blazed off; which not only imparts additional toughness, but coats the exterior with a sort of oily varnish, and thereby offers a preservative against rust." (9.)

In a former paper (10), I stated that I had witnessed many attempts to weld cast steel either to itself or to iron, but, in every instance, the effort was unsuccessful; I farther stated that, to the best of my knowledge, the problem had never been satisfactorily solved. Mr. Gill rightly observes, "This is a very difficult process, and not to be done but by skilful and careful workmen, on account of the cast steel becoming so fragile when highly heated. The art, however, is this—to heat the iron to the highest degree it will bear, and the steel as hot as it will safely allow; then laying them together, the extra heat of the iron will cause them to unite, by hammering. Hammer-faces are steeled in this manner, and prove very durable in use. Dies for stamping medals, coins, &c., are made in a somewhat different manner. A cylinder of cast steel is enclosed in a hollow ring or cap of iron, which protects it in the fire from being too highly heated; and, when carefully welded, the outer surface of the steel is cut away, and a die, combining the hardness of steel with the toughness of iron, is thus formed. These dies are hardened, after being properly heated, by placing them under a stream from a column of water of considerable height, and removing the air-bubbles, which form while they are cooling." (11.)

"In the operation of welding cast steel to iron, it being necessary to bring the bodies which are to be united, into a state of partial fusion; and as heating cast steel sufficiently for that purpose, destroys it altogether, it occurred to Mr. William Thurnall, that some chemical agency might facilitate the union. 'I tried,' observes Mr. T., 'the fixed alkalies, with powdered silex, and a variety of other things, but have found nothing answer so well as *sulphur*, either by itself, or in combination with a fixed alkali; I also tried borate of soda with sulphur; but think the result was in favour of sulphur by itself.

"'The management is extremely simple; nothing more is requisite, than to bring the iron nearly to a welding heat, and the steel to that degree of heat it will bear without injuring its quality, having upon the forge a small quantity of the flowers of sulphur; while in this state, the two surfaces to be welded, are to be instantly drawn across the sulphur, which immediately produces superficial fusion, and then applied with as much celerity as possible to each other, hammering upon the anvil in the usual manner. I have,' concludes Mr. Thurnall, 'tempered the steel when united in this way, and can perceive no deterioration in its quality.'"* (12.)

The details of this process are curious, and certainly deserve consideration; yet, after all, it cannot be esteemed fair and legitimate welding: the method recommended by Sir Thomas Frankland, noticed in a former paper, to whom we are indebted for the first accurate information on this *vexata questio*, so interesting to mechanics, fulfils our ideas of what is meant by welding in a technical sense; inasmuch, that it dispenses with the aid of any foreign substance; but then, however dexterously managed, the steel is liable to be injured. The late Mr. Samuel Varley assured Mr. Gill, "that he had seen a smith frequently weld pieces of cast steel together, without the slightest injury; and, in this way, *he would unite two worn-out mill-wright's picks into a new and serviceable one.* In order to test the value of this man's process, Mr. Varley broke a bar of superior cast steel into two parts, and requested the smith to unite them again, which he did, without affecting the quality of the steel in the least degree." Mr. Gill propounds, on competent authority, this apparently paradoxical theory—viz. "*That cast steel may be welded even with greater ease than iron; as the welding heat of the former is considerably below that of the latter.*" Now this doctrine, contradictory as it seems, is, in reality, a very near approximation to the truth, and, consequently, enables us to solve the difficulty; "as the principal cause of failure in persons attempting to weld cast steel is, that they heat it too much, conceiving that it requires to be treated like iron, whereby it is totally destroyed.

"It is to be observed, however, that steel requires a different flux from iron, to prevent oxidation, to which it is extremely subject; and that the welding-sand used for iron, is totally unfit for this purpose. The *glass of borax* reduced to *fine powder*, or the greenish-black glass of which common bottles are made, has been strongly recommended; as it consists of sand and alkali only, without the presence of lead, as in flint glass. It has been suggested, that an additional portion of the alkali would materially improve the flux.

"In order to promote the success of welding cast steel, we cannot too strongly insist on the employment of charcoal, in preference to mineral coal, for the fire. The pieces to be united, after being formed of a proper shape, should have the surfaces, intended to be joined, filed bright, coated with borax, and firmly bound together with iron wire, previously to being put into the fire; or the flux may be applied to the parts when heated sufficiently to fuse it. Whether the union be effected with or without the intervention of a flux, it is important to bear in mind, that the *lower* the heat, within certain prescribed limits, the greater the probability of success." (14.)

"Steel or iron may be annealed without oxidizing or scaling the surface, by merely enclosing the articles in cast-iron vessels, and surrounding them with *ground flint*, such as is used in the manufacture of pottery. The cast-iron vessels must be provided with closely-fitting lids, and the joints well luted, so as entirely to exclude the atmosphere; they are then to be exposed to a red heat in a furnace:" of course the duration of the process must depend on the size and thickness of the materials under treatment. A little experience will enable the operator to determine this more accurately than any written instructions.

"Another method is, to place the articles in cast-iron vessels, surrounded with

* This process of Mr. Thurnall is quite at variance with the acknowledged pernicious property of sulphur in regard to steel. In this, as in every other extract, we have faithfully recorded the opinion of the writer, and leave the reader to exercise his own judgment.

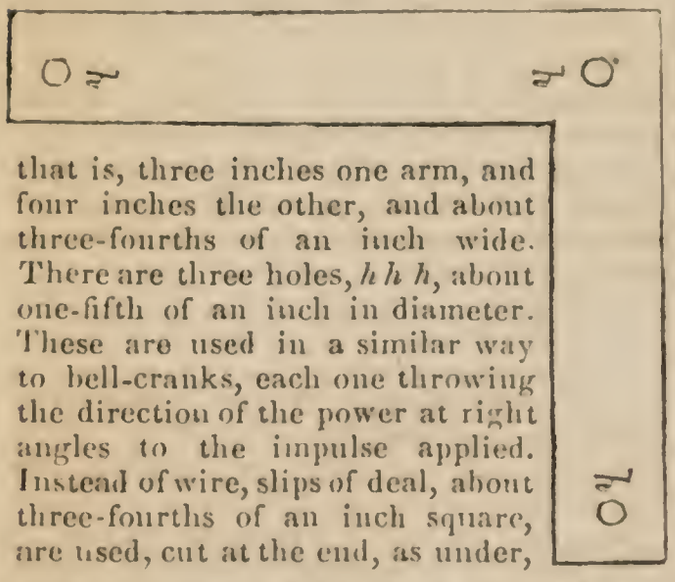
melted lead, the surface of which is covered with a stratum of charcoal, to prevent oxidation; then to let it become nearly cold, before taking out the iron or steel. (13.)

"It is very singular, that cast steel should be *softened* by the very same means that are ordinarily employed to *harden* it, and yet such is the fact!"

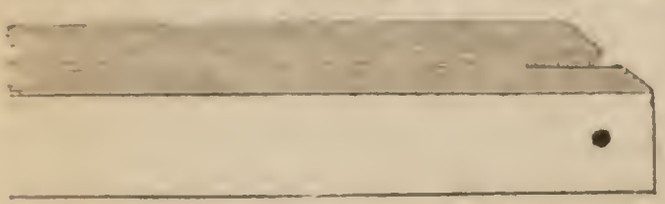
MECHANISM OF ORGANS.

To the Editor of the Penny Mechanic and Chemist.

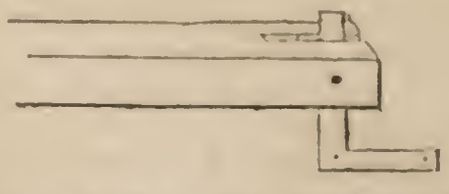
Sir,—In answer to "An Amateur," I beg leave to state, that I am not at all surprised at his not perceiving readily how the cranks act in drawing out the stops; for the sketch I sent, having been hastily done in pencil, was probably rubbed, and the engraver has, through my carelessness, been led into an error. Any mechanical arrangement may be used to effect the desired purpose; cranks are used to alter the direction of the power applied. They are generally made of iron, about one-eighth of an inch thick, and about the shape of the following sketch—



that is, three inches one arm, and four inches the other, and about three-fourths of an inch wide. There are three holes, *h h h*, about one-fifth of an inch in diameter. These are used in a similar way to bell-cranks, each one throwing the direction of the power at right angles to the impulse applied. Instead of wire, slips of deal, about three-fourths of an inch square, are used, cut at the end, as under,



with a notch, into which the end of the crank is placed, and a piece of iron wire run through the hole, so as to form a sort of hinge, thus:—



With regard to the usual stops in an organ, limited to four or six (which, by the way, would be quite as many as would be agreeable in a room), of course it depends, in a great measure, on the taste of the person requiring the instrument; but the *principal*, and one of the *diapasons*, ought to form part of every organ. I should strongly recommend the following scheme, as giving the greatest possible variety, combined with moderate power—viz.

1st. Stopt diapason—wood.
2nd. Principal—metal.
3rd. Dulciana—metal.
4th. { Flute, to middle C / Double stopt diapason in bass. } wood.

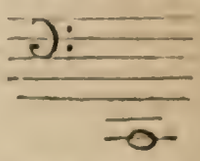
If the expense of six stops would not be an object, I would add to the above—

5th. Cremona—metal reed stop; or, which is better still—

5th. { Hautboy treble / Bassoon bass } metal reed stops.

6th. Open diapason—metal; or, fifteenth—metal.

He must be governed, in some measure, by the height and space he can spare, to place the organ when made. A dulciana



pipe, or any open pipe to

would be about eight feet long; and the organ is generally made to F, below that which would take an open pipe about ten feet in the speaking part.

I would also particularly advise, that all the stops should have the bass and treble to draw separately, so that the bass of one could be played with the treble of another. This will have nearly as good an effect, as if there were two rows of keys. It would also be an improvement to have the whole placed in a general swell. If he cannot spare sufficient room in height for the long pipes, it could be got over by stopping the lower octave of the dulciana, and placing a single diapason in the bass part of the flute stop, &c.

As to a place where to purchase organ pipes cheap, I know of none, for they are confoundedly expensive things. However, I could probably obtain some second-hand, at a moderate price; but I know it would be useless to inform you where; as, unless you were acquainted with an organ-builder, you would stand no chance of getting anything even second-hand, but at a great price; as they, of course, do not wish to encourage amateur organ-build-

ing. Should you really intend purchasing some pipes, I shall have much pleasure in assisting you, to the best of my power, in procuring them at a reasonable rate, and, in order to do so, would introduce you to an eminent organ-builder, who would let you have what you required (even second-hand, if you preferred it), on my introduction, at a professional price.

I intend sending a paper on tuning the organ, to the Editor shortly, and, as it will probably appear, it is scarcely worth while saying anything on that subject at present. Any farther information you may require, I shall be happy to afford.

I remain yours, &c.,

G. S., Jun.

DESCRIPTIVE GEOLOGY.

(Continued from p. 127.)

NEWER PLIOCENE PERIOD *(continued)*.

OSSIFEROUS CAVES.

SOME of the most celebrated ossiferous caves are those of Franconia, the Cave of Chockier, near Liege; Paviland, Glamorganshire; Wokey Hole, in the Mendips; Bize, in the department of Aude; Kirkdale, &c. Several occur in Switzerland, and along the Mediterranean shores, and in its islands. Caves of this kind are likewise found in India, North and South America, and Australia.

GAYLENREUTH.

The most remarkable cave of Franconia, is that of Gaylenreuth, which lies to the north-west of the village, on the left bank of the river Wiesent. The entrance, which is about seven feet high, is in the face of a perpendicular rock, and leads to a series of chambers, from fifteen to twenty feet high, and several hundred feet in extent, terminated by a deep chasm. The floor is literally paved with bones and fossil teeth; and the pillars and corbels of stalactite also contain osseous remains. Loose animal earth, abounding in bones, forms, in some parts, a layer ten feet in thickness. M. Esper published a highly graphic description of this cave about seventy years ago.

FORSTER'S HÖHLE.

Another cavern, in this part of Germany, is mentioned by Dr. Buckland, as one of the most remarkable for the beauty of its incrustations. Its height varies from ten to thirty feet, and its greatest width is about ten yards. In the side recesses, which descend at an angle of 45o into the main chamber, the stalagmite has formed the appearance of cascades of pure alabaster, the waves of which seem to be rushing out at the bottom, to pour themselves into the stagnant lake of the same substance which covers the floor. The rocky roof has been corroded into deep cavities, which are separated by partitions of every conceivable form and tenuity, giving it the appearance of the richly-fretted Gothic roof of a chapel, with pendent corbels. Beautiful stalactites,* depending from these projections, reach almost to the floor, and contribute, by their delicacy and transparency, to give additional richness to the scene.

KIRKDALE.

Kirkdale Cave had a nearly level floor, parallel to the oolitic limestone strata; its extent was 245 feet; the height varied from three to six feet, or more. On the rocky floor was generally a bed of mud, covered over by an irregular layer of sparry stalagmite, formed by the dropping of water containing carbonate of lime in solution; and it was in this stalagmite, and in the mud below it, that the bones were found.

The bones were almost universally broken; the fragments exhibited no marks of rolling in water, but a few were corroded, some worn and polished on the convex surface, and many indented, as if by the canine teeth of carnivorous animals. In the caves, the peculiar excrement of hyenas (album græcum) was common.

GENERAL THEORY OF OSSIFEROUS CAVES.

We may account for the existence of many cavities in the interior of the earth, by the simple agency of earthquakes; but there are some caverns, especially in limestone rocks, which, although usually, if not always, connected with rents, are, nevertheless, of such forms and dimensions, alternately expanding into spacious chambers, and then contracting again into narrow passages, that it is difficult to conceive that they can owe their origin to the mere fracturing and displacement of solid masses. M. Virlet is of opinion, that some fissures were at first caused by earthquakes, and that these fissures became the chimneys or vents for the disengagement of gas, generated below by volcanic heat. Gases, such as the muriatic,

* For the mode of the production of stalagmites and stalactites, see "Saturday Magazine," No. 42.

sulphuric, fluoric, and others, might, if raised to a high temperature, alter and decompose the rocks which they traverse. We may suppose that, afterwards, the elements of the decomposed rocks were gradually removed, in a state of solution, by mineral waters.

When a mass of cavernous rock is raised above the level of the sea, it will usually be intersected by ravines and valleys; and it must then happen that, here and there, a torrent or river will break into some cavern. Accordingly, engulphed streams occur in almost every region of cavernous limestone—as in the north of England, for example. But these streams do not always issue from the same openings; they sometimes change their course, and come out of a cave whence no water had previously flowed. We must suppose that the dens of wild beasts would sometimes be inundated by these subterranean floods, and their carcasses buried under the alluvium brought in. The bones, moreover, of individuals who have died in the recesses of caves, or of animals which have been carried in for prey, may have been drifted along, and mixed up with mud, sand, and fragments of rocks, so as to form osseous breccias. For a more extended account of the origin of ossiferous caves, see the third volume of Lyell's "Principles of Geology," page 210, *et seq.*

THE FRANKLIN MEMORIAL.

A PROSPECTUS, of which the following is a copy, has been put into our hands, and we most cheerfully give it insertion; hoping that it may be the means of contributing, in some measure, to the success of so desirable an object. The greatest praise is due to Messrs. Harrild, for the very liberal and benevolent manner in which they have instituted so laudable an undertaking; and we trust, that not only the object proposed may be fully attained, but that it may prove to be only the commencement of a fund which will greatly increase and extend its benefits throughout many generations:—

"The existence of the identical press at which Dr. Franklin worked as a journeyman printer when in London (in 1726), having been mentioned in the 'Athenæum,' many persons were induced to visit the warehouse of Messrs. Harrild, in whose possession it then was, and among them Mr. J. B. Murray, of New York, who expressed a desire that the venerable relic should be preserved in the Museum of the Philadelphia Philosophical Society, as a memorial of his illustrious countryman. To this national good feeling, Messrs. Harrild cheerfully responded, declining any price; but, wishing to make it instrumental in forwarding a work of charity in favour of decayed printers, proposed that a donation should be made for that purpose. The Society's constitution precluding any such arrangement, it was at once given unconditionally, and the press is now on its way to America. On its arrival at Liverpool, Mr. Murray, being anxious to carry out the benevolent intention of the donors, caused it to be exhibited, and a public lecture was given by the Rev. Hugh M'Neile, on the Life of Franklin. The result was, a net sum of 150*l.* So unexpected and welcome an issue, has led to the proposal of founding a Memorial of the philosopher, and making this sum the nucleus of a subscription for the establishing of a pension or pensions bearing his name, in favour of indigent printers. It is proposed to found two pensions, if the funds will admit; one of 30*l.* for a decayed master printer, whom misfortune has "reduced to the ranks," and one of 20*l.* for a decayed overseer who has served five years in an office with credit, or, failing any such applicant, a journeyman who has retained a situation for the same period—to be called the 'Franklin Pensioners.' Thus, as was observed by Mr. Murray, 'each country will be put in possession of a new memorial of Franklin: America of her citizen's Press, and England of an endowment bearing his name, directly resulting from the fact of his having worked at an English press, and in accordance with his benevolent and provident disposition.' The above-named lecture has been published, and the proceeds of the sale in England and America, and farther subscriptions, will be added to the fund; and contributions, not only from the English public, but from the American nation and the colonies, are confidently anticipated: in short, wherever an English press has been set up (for it has now become universal*), a collection should be made, and contributed to by all who feel that they are indebted to the printer's art for the intellectual enjoyments of social life. The name of Franklin will ever be associated with that invaluable art, and his example serve to stimulate aspiring

* So great has been the spread of the art of printing and the English press, that one manufacturer has, in the last fifteen years, sent out upwards of 1500 presses to all parts of the world! If but a guinea were contributed by each of the respective parties, it would make a sum sufficient for the object proposed.

youth in the pursuit of its exercise. Many are they who have profited by his precepts; and his interesting autobiography has served for a chart to the young adventurer, by which to steer in the voyage of life. Let all those who have so profited —all who have attained success by following his course, look with compassion on those who have foundered or failed in the struggle with adversity. It is hoped, at least, that in every printing-office in the kingdom a collection will be made; and that every American residing in England, will hasten to inscribe his name in so praiseworthy a record, in testimony of his approbation of the Franklin Memorial. The facilities of the post-office will enable every individual to contribute his mite, which will be thankfully received.

Amount of subscriptions and donations already received..	42	0	0
Proceeds of a lecture delivered by the Rev. Hugh M'Neile at Liverpool, on the Life of Dr. Franklin	131	11	0
Donations from visiters to the Franklin Press, during its exhibition at the Medical Institution, Liverpool	15	18	4

Subscriptions will be received by the following bankers:—Messrs. Rogers and Co., 29, Clement's Lane; Stevenson, Salt, and Sons, 20, Lombard Street; and by Marchant, Smith, and Co., Printers, Ingram Court, Fenchurch Street; and Harrild and Sons, 11, Great Distaff Lane, Friday Street."

THE CHEMIST.

CHLORINE.

The introduction of this term marks an era in chemical science; it originated from the masterly researches of Sir Humphry Davy upon the oxymuriatic acid of the French school; a substance which, after resisting the most powerful means of decomposition which his sagacity could invent, or his ingenuity apply, he declared to be, according to the true logic of chemistry, an elementary body, and not a compound of muriatic acid and oxygen, as was previously imagined, and as its name seemed to denote; he accordingly assigned to it, descriptive of its colour, the name of chlorine; and which, should any other chemist, at a future time, discover chlorine to be a compound, would not be wrong. To obtain it, mix cautiously in a retort one ounce of binoxide of manganese, with three, by measure, of muriatic acid. Muriatic acid consists of hydrogen and chlorine, two atoms of which, with one of the binoxide of manganese, produce chlorine, water, and muriate of manganese, which remain in the retort.

There is also another way, which produces the gas much quicker, but not quite so pure:—Pour on some chloride of lime, an equal quantity of muriatic acid, and collect the gas as it comes over. Both cold water and mercury absorb this gas; so it is best collected over warm water. Its colour is a yellowish green; its taste is astringent; smell suffocating. It is extremely irritating to the lungs; and all experiments with it ought to be performed where, if any of the gas escape, it can easily be carried away by the air. It is rather heavier than the atmosphere; it possesses few acid qualities. It entirely discharges all colouring matter; but, to do this, they ought to be first wetted with water. To prove this, make a solution of chlorine in water, and add a portion of the solution to water tinged with vegetable blue; it is immediately blackened; the chlorine decomposing the colouring matter, by taking hydrogen in it to form muriatic acid. The simple bodies—phosphorus, tin, copper, and zinc, burn spontaneously in this gas; arsenic, manganese, tellurium, antimony, and mercury, will also burn in this gas, if their temperatures are first raised to about 90°. Mercury produces corrosive sublimate, by being burnt in this gas. All metals burn in this gas when heated, except gold, silver, cobalt, nickel, and lead. The simple bodies, potassium, sodium, calcium, iridium, barium, zinc, mercury, tin, antimony, silver, and gold, have a stronger affinity for this gas than for oxygen.

Chlorine will also support combustion: to prove this, first introduce a candle into a jar containing it, and it will burn with a lucid flame; secondly, introduce into a detonating jar two-thirds full of chlorine, carburetted hydrogen, and apply a light; an explosion ensues, the chlorine takes hydrogen from the gas, producing muriatic acid, and carbon is deposited; thirdly, mix equal bulks of chlorine and hydrogen gases, and apply a light; they combine with explosion, and form muriatic acid. This gas has been employed in cases of scarlet fever, with the utmost success. Its chief compounds are muriatic acid, chlorate of potass, and common salt. Muriatic acid is a gas which is condensed, in large quantities, by water; this is gene-

rally called spirits of salt. Chlorate of potass is a compound of chloric acid and potassa, and is formed by the actions of chlorine, water, and potassa. It is a very explosive compound, and very often explodes spontaneously. Berthollet, from this character, was induced to think it might be used in gunpowder instead of nitre. This was tried, but it instantly exploded, blew the mill to pieces, and killed two persons who happened to be near it. Take four grains of chlorate of potass, and two grains of sulphur; on putting this powder on a shovel over the fire, a loud report will be heard. Mix four grains of chlorate of potass and six grains of sugar; let a single drop of sulphuric acid fall upon this mixture, and an explosion, attended with light, will be the consequence. A mixture of this salt with arsenic, furnishes a detonating compound, which takes fire with the utmost rapidity. If two long trains be laid on a table, one of gunpowder and the other of this mixture, and they be in contact with one another at one end, so that they can both be fired at once; the arsenical mixture burns with the rapidity of lightning, while the other burns with comparative slowness. Our common table-salt is a chloride of sodium; some say it is only so when in a dry state, and that when it imbibes moisture from the air, it takes one equivalent of hydrogen to the chlorine, to become muriatic acid, and another equivalent of oxygen to the sodium, to form soda; and so is a true muriate of soda. If any of your correspondents could find out any way to prove this or the contrary, I should feel obliged.

C. M.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, April 13, G. Greig, Esq., on the Education of the Blind. Friday, April 15, G. F. Richardson, Esq., on the Public Press. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, April 14, Harman Lewis, M.A., on the Evolution of Heat and of Light from Chemical Combination. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, April 14, E. W. Elton, Esq., on the Genius of Shakspeare. At eight o'clock.

QUERIES.

The most easy and plain method of calculating the horse power of a marine engine? W. S.

The best way to make solder for soldering Leyden pipes and tin-work? Also, to make brass solder for bronzing copper? J. Sheppard.

How to make a good polish for calf-skins? In finishing, they are brushed over with lamp-black and oil, to make them black, and then done over with a mixture of size, oil, tallow. Now I want something to mix with these ingredients, to make a better polish, which will not peal off or turn white. John Smith.

The best method of laying out tooth-wheels? Likewise, what composition is used, instead of paper, for calender rolls, in the north of England? Which is the best wood to stand heat and pressure? A. S.

Which is the best book on bleaching? Z. Z.

Whose is the best system of short-hand, or that most generally practised by the reporters of the House of Commons? W. W.

To make a good common lute that will resist hot oil? Of what are the imitation meerchamms made? T. B.

How to clean coloured kid gloves, such as lavender, fawn, &c.? N. S. S.

Is the plate zinc used for sponting, the zinc "W. H." alludes to? Is the zinc to be amalgamated on both sides? After being bent into a roll, must it be soldered; if so, must it be hard or soft solder? Is there any economical composition with which I could make porous jars? Would pipe-clay do? E. W. Newton.

How to mix the metal of which table and teaspoons are made, called German silver, Britannia, and tutenag; how to give them a good tone, and how they are finished after coming from the mould? W.

ANSWERS TO QUERIES.

"Utile." Some make the composition in question, of bees' wax, coloured with lamp-black, and rubbed into the lines.

"W. Courtney." As an impression cannot, by any means, be taken from a print without abstracting a portion of ink from it, it follows that it cannot be performed without injury to the original. The composition he has used for his electrophorus, is not exactly similar to that usually prescribed; it should be—pitch, 1 part, resin, 4 parts, and bees' wax, 1 part. When the resinous plate is warmed and rubbed, the upper plate is to be put on it; the glass handle having been previously dried. By then lifting up the upper plate by the handle, a spark may be obtained from the edge; touch it, and again put it down; on raising it a second time, another spark will be obtained, and so on for a considerable period.

W. H.

TO CORRESPONDENTS.

G. S., Jun.—*His paper on tuning the organ, we shall be happy to receive.*

London: Printed at "The City Press," 4, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 77, THIRD SERIES. | SATURDAY, APRIL 16, 1842. | No. 325, OLD SERIES.

HIGGINBOTTOM'S CONCUSSION COCK.

FIG. 1.—SIDE VIEW.

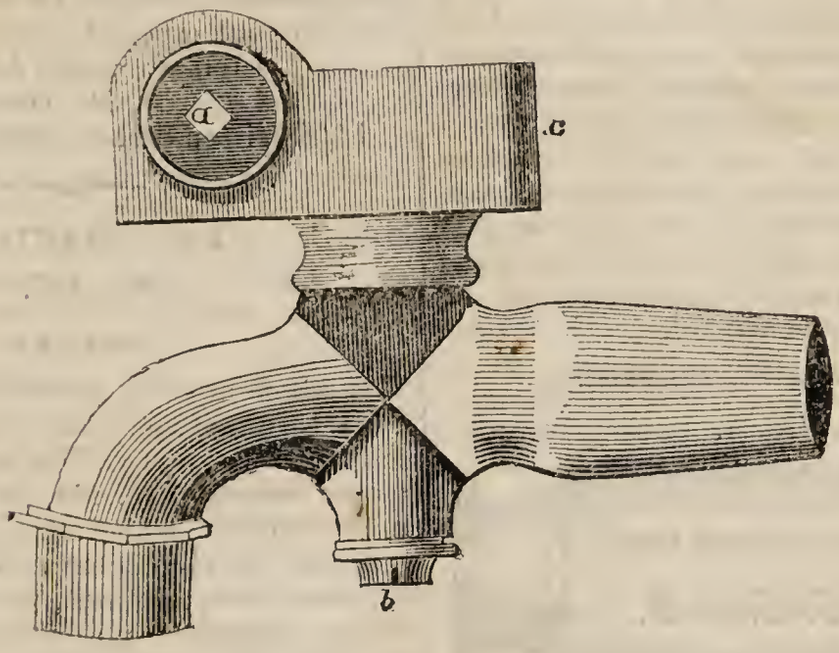
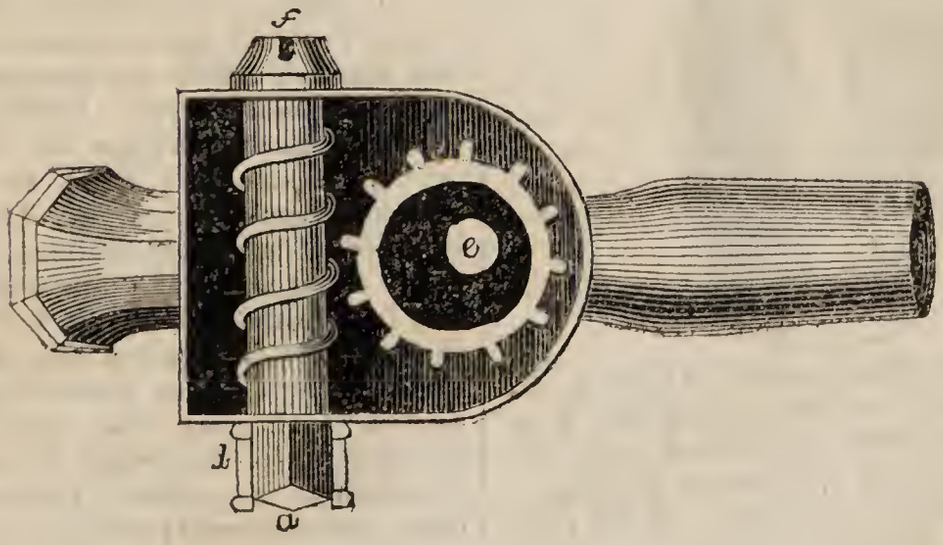


FIG. 2.—INTERIOR VIEW.



Vol. VIII.—No. 18.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

HIGGINBOTTOM'S CONCUSSION COCK.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—I have sent you a sketch of an improved concussion cock, invented by me. The superiority of these cocks over those commonly used, consists in preventing the sudden concussion of the water, caused by shutting off the cock too quickly, which, in many cases, causes the bursting of the pipes. I have witnessed thousands of cases of this kind, being constantly employed in repairing them. I have now a few of these cocks in my possession, of which I have made trial, and which, I am happy to say, answer my expectations. One of these cocks, with all their utility, will not exceed double the value of a common tap; so that, considering the many mishaps which attend the common cock, would all be avoided, I think, that to persons having a quantity or even one of these taps in their possession, they would be found essentially beneficial.

Description of the Engravings.

Fig. 3.

Fig. 1 is a side exterior view; *a* is a steel pin, to which the turning key is attached, which turns the endless worm (described in fig. 2), and moves the cog, *e*, which is fastened to the plug of the cock. By working on this principle, it is impossible to shut the water off so quickly, as to cause the rebounding which is heard when the tap is shut off suddenly. I have witnessed cases in which it has blown leaden pipes out like a bladder; even those which we call three-quarters and five-eighths, and weigh from eight to ten pounds per yard.

Fig. 2 is an interior view, which shows the worm and cog, which are fastened to the plug. This worm is made of brass, with a steel pin through its centre, on which the key fits; *d* is a press, which secures the pin from being turned without a proper key; *f* is a set screw, which keeps the worm in its place.

Fig. 3 is a front view of the cock, on which is my name. Several patents have been obtained for taps, purporting to prevent concussion, which I have tried; but none of them, I think, are by any means so competent to fulfil the duty for which they were invented, as the one which I offer to your especial notice.

I remain yours, &c.,

J. H. Higginbottom.

14, Division Street, Sheffield.

PNEUMATICS.

No. III.

AIR-PUMP.

The air-pump was invented in the year 1654, by Otto Guericke, a native of Magdeburgh, in Germany; but we are indebted to our countryman, Mr. Boyle, for those improvements which have rendered this machine of such great utility. In philosophical investigations, it frequently becomes necessary that substances, which are the subjects of experiment, should be removed from the influence, whether mechanical or chemical, of the atmosphere. For this purpose, it is desirable that we should possess the means of withdrawing the air from a glass vessel, called a receiver, in which the substance is received, and through which the changes it undergoes may be observed. I shall devote the present paper to explain the construction of this instrument, and the principle which governs its action. The air-pump is, in effect, precisely similar to the water-pump; and whoever understands the one, will have little difficulty in understanding the other. The air-pump is exhibited under various forms, each of which is attended with particular advantages and disadvantages, according to the purposes to which it is applied. There are, however, some general principles in which all of them agree, and which I will explain. The air-pump consists of a glass vessel, closed at the top, but open at the bottom. This vessel, which is termed a receiver, must have its lower edge ground perfectly smooth or air-tight—that is, it must not let out or in any air at its edges, when

placed on the pump-plate. If the receiver be not sufficiently ground for this purpose, a little unctuous matter rubbed on its edge, will effectually insure its close contact with the plate. In the plate is a small aperture, which communicates, by a tube, with a cylinder, in which a piston is moved; the piston-rod moves in a collar, and a valve is placed in the bottom. We will suppose the air in the receiver, the pipe connected with it, and the barrel, to have the same density as the external air; upon drawing off the piston, the air in the barrel or cylinder will be drawn out, and a vacuum formed underneath the piston. The air in the receiver will, by its elasticity, force against the valve at the bottom of the cylinder, and rush up to fill the vacant space. When the piston is forced down again, it compresses the air beneath it, which closes the valve at the bottom, and, at the same time, opens the valve in the piston, and the compressed air, by this means, escapes; thus a quantity of air, equal to the capacity of the cylinder, is got rid of; a second lift will withdraw a second portion, and so the operation may be continued at pleasure. But even now, we are far from having a real vacuum in the receiver; for the expanding properties of air are such, that the smallest portion will as completely fill the receiver as ever. This explanation relates to the single-barrelled air-pump; but the double-barrelled pump will be easily understood. The tube which proceeds from the pump-plate, is branched so as to communicate with two barrels instead of one; each of these is furnished with its valve and piston, and are moved alternately up and down by means of a small wheel and rack.

G. STARKEY,
Mineralogical Chemist.

Church Street, Shoreditch.

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS.

(Continued from page 125.)

WE have constantly observed, that those parts of the stems of drills, which immediately adjoin the hardened points, are found to twist much more than any other parts; and, in like manner, that those parts of chisels, punches, &c., which are similarly situated, are exceedingly apt to bend, unless made much stronger than would otherwise appear requisite. Yet, notwithstanding the continual recurrence of these parts, no practical deduction seems to have been made therefrom by workmen in general. Some judicious persons, however, have advantageously availed themselves of this singular property, by which they are enabled not only to anneal cast steel in much less time than by any other method, but also to free it entirely from those hard spots, technically called *pins*, which occasion so much trouble and loss of time to the workman during the operation of filing or turning.

The process consists in carefully heating the steel, *nearly* to the hardening point, and instantly quenching or cooling it in water; and the *nearer* that heat approaches the hardening point, the *softer* the steel will become.

Cast-steel articles ought always to be thus annealed, previously to planishing or condensing them by hammer-hardening; and it is wonderful how much they will stretch under the hammer, after being so treated."

"The principal difficulty in hardening cast steel, is to ascertain the exact limit of heat, as a very trifling excess is sufficient to deprive it of its most valuable properties; hence, in order to obtain the edges or points of delicate instruments of the greatest degree of strength, for important purposes—such, for instance, as the edges of cutters for dividing mathematical instruments, which require extreme fineness, combined with strength—Mr. Stancliffe, a *protegé* of the celebrated Ramsden, adopted the following excellent method:—After shaping the tool, and condensing it by hammering, he carefully heated the point and quenched it; then, with the edge of a file, he made trial, by filing along from the soft and unhardened part, to that part where it became hard; and formed the cutting edge by grinding and whetting *that* part to shape. He was thus assured of the quality of his tool being the best that the steel employed could possibly produce; nor did it require tempering as usual."

"The hardening and tempering of steel is a process," observes Mr. E. Rhodes, "extremely simple; it requires more of *care* than skill, on which account it is, in general, performed by workmen but very inadequately rewarded; yet, in the manufacturing of an edged instrument, much depends on the nice management of this very simple operation, which either imparts a value to, or renders nugatory, all the labour that precedes, and all that follows it."

A very general opinion is entertained by men accustomed to the management of this process, that, if steel be overheated previously to immersion, an extra portion of heat is likewise required to re-

duce it, or what is termed, *let it down* to a proper degree of hardness, and that without this, a good cutting edge cannot possibly be produced. This, to say the least of it, is a miserable and inefficient attempt to remedy one error by the introduction of another. It may be laid down as a position—which is not in much danger of being controverted—that the *lowest possible heat* at which steel can be worked and become hard, is, unquestionably, the best; and that to impart to it any extra portion, is essentially to deteriorate its most valuable property. If *over-heated*, the pores of the metal become open and expanded, the firmness of its texture is destroyed, and *it is rendered incapable of sustaining a cutting edge!*

It must not, however, be inferred from these remarks, that any degree of *temper* whatever will operate to restore to steel, the properties of which it has been deprived, by being *over-heated*. Workmen, acting under the influence of the preposterous opinion here deprecated, manifest great carelessness in the performance of this very critical operation of hardening; always imagining, that the evil effects of this carelessness may be remedied, by resorting to a practice evidently erroneous.

"The reader is desired to keep in mind the position just laid down, that the *lowest possible heat at which steel can be worked and hardened, is undoubtedly the best.* To men at all acquainted with the nature of steel, no argument will be necessary to establish this important fact; those who are not—and these constitute by far the larger number of practical mechanics—we refer to the foregoing and subsequent observations."

One of the chief obstacles to the advancement of mechanical science among the working classes, is, that the languages of theory and practice are essentially different; in short, nothing is more difficult than to delineate or describe machinery in terms simple and intelligible. "The phraseology of books and every-day life, when applied to subjects intimately connected with a particular manufacture, furnishes no expressions by which the meaning can be so accurately conveyed, as by the *technicals of the workshop*; these are always at hand, and the mind continually recurs to what it cannot use; it finds a task imposed upon it—not unlike translating from one language into another, by which the sense suffers by diffusion—and yet cannot possibly be compressed;"* an idea well expressed by the Roman poet—

"Brevis esse laboro, obscurus fio."

At almost every sentence I have been met by this difficulty, yet, regarding the *matter* rather than the *manner*, I found it necessary to break through the trammels of rule, and, by sacrificing the sound to the sense, I venture to indulge a hope, that I have succeeded in making myself understood.

It will not, I apprehend, be irrelevant to the subject to inquire, and, so far as is practicable, to determine, what *angle* is most suitable for the cutting edge of tools for turning or planing metal, more especially as the operation is usually one of mere accident, instead of being, as it ought, based on, and governed by, scientific principles.

Before doing this, we will retrace our steps, and endeavour to apply the information we have acquired; as, unless it can be made beneficially available in the workshop and manufactory, the labour bestowed is just so much time fruitlessly employed.

HISTORY AND PROGRESS OF THEORETICAL AND PRACTICAL MECHANICS.

No. III.

THE application of statics to the equilibrium of machines, was first made by Varignon in his "Project of a New System of Mechanics," published in 1687. The subject was afterwards completely discussed in a posthumous work, published in 1725. In this work are given the first notions of the celebrated principle of virtual velocities, from a letter of John Bernouilli to Varignon, in 1717. The virtual velocity of a body is the infinitely small space through which the body excited to move, has a tendency to describe in one instant of time. This principle has been successfully applied by Varignon to the equilibrium of all the simple machines. The resistance of solids, which was first treated by Galileo, was discussed more correctly by Leibnitz, in the "Acta Eruditorum" for 1687. In the Memoirs of the Academy for 1702, Varignon has taken up the subject, and rendered the theory much more universal.

An important step in the construction of machinery was, about this time, made by Parent. He remarked, in general, that if the parts of a machine are so arranged, that the velocity of the impelling power becomes greater or less, according as the weight put in motion becomes

* "Essay on the Manufacture, Choice, and Management of a Razor," 1821. See also, "Technical Repository," vol. viii., p. 47—51.

greater or less, there is a certain proportion between the velocity of the impelling power, and that of the weight to be moved, which renders the effect of a machine a maximum or a minimum. He then applies this principle to undershot wheels, and shows that a maximum effect will be produced, when the velocity of the stream is equal to thrice the velocity of the wheel. In obtaining this conclusion, Parent supposed, that the force of the current upon the wheel, is in the duplicate ratio of the relative velocity, which is true only when a single float-board is impelled by the water. But when more float-boards than one are acted upon at the same time, it is obvious that the momentum of the water is directly as the relative velocity; and, by making this substitution in Parent's demonstration, it will be found that a maximum effect is produced, when the velocity of the current is double that of the wheel. This result was first obtained by the Chevalier Borda, and has been amply confirmed by the experiments of Smeaton. The principle of Parent was also applied by him to the construction of windmills. It had been generally supposed, that the most efficacious angle of weather was 45°; but it was demonstrated by the French philosopher, that a maximum effect is produced when the sails are inclined $54\frac{2}{3}°$ to the axis of rotation, or when the angle of weather is $35\frac{1}{3}°$. This conclusion, however, is subject to modifications, which will be pointed out in a subsequent part of this article.

The publication of Newton's "Principia," contributed greatly to the progress of mechanics. His discoveries concerning the curvilineal motion of bodies, combined with the theory of universal gravitation, enabled philosophers to apply the science of mechanics to the phenomena of the heavens, to ascertain the law of the force by which the planets are held in their orbits, and to compute the various irregularities in the solar system, which arise from the mutual action of the bodies which compose it. The "Mechanique Celeste" of La Place, will be a standing monument of the extension which mechanics has received from the theory of gravity. The important mechanical principle of the conservation of the motion of the centre of gravity, is also due to Newton. He has demonstrated, in his "Principia," that the state of the centre of gravity of several bodies, whether in a state of rest or motion, is not affected by the reciprocal action of these bodies, whatever it may be; so that the centre of gravity of the bodies which act upon one another, either by the intervention of levers, or by the laws of attraction, will either remain at rest, or move uniformly in a right line.

We have already seen, that the principle of the conservation of active forces, was discovered by Huygens, when he solved the problem of the centre of oscillation. The principle alluded to consists in this, that in all the actions of bodies upon each other, whether that action consists in the percussion of elastic bodies, or is communicated from one body to another by threads or inflexible rods, the sums of the masses multiplied by the squares of the absolute velocities, remain always the same. This important law is easily deducible from two simpler laws admitted in mechanics. 1st. That in the collision of elastic bodies, their respective velocities remain the same after impact, as they were before it; and, 2ndly. That the quantity of action, or the product of the masses of the impinging bodies, multiplied by the velocity of their centre of gravity, is the same after as before impact. The principle of the conservation of active forces, was regarded by its inventer only as a simple mechanical theorem. John Bernouilli, however, considered it as a general law of nature, and applied it to the solution of several problems, which could not be resolved by direct methods; but his son Daniel deduced from it the laws of the motions of fluids from vessels—a subject which had been formerly treated in a very vague manner. He afterwards rendered the principle more general, and showed how it could be applied to the motion of bodies influenced by their mutual attractions, or solicited towards fixed centres by forces proportional to any function of the distance.

LATHE-DIVIDING PLATE.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I am much gratified by the candour and practical sound sense evinced by your correspondent "A. B.," in his letter (No. 70, page 84), respecting an improvement I had suggested for the dividing apparatus of a lathe (No. 66, pp. 51 and 52), instead of the plate commonly employed for that purpose.

The unbiassed judgment of men actually engaged in mechanical pursuits, is invaluable to the theorist; because the daily routine of their occupation, necessarily imparts that accurate knowledge of ma-

chinery in detail, which cannot otherwise be obtained. I am, therefore, anxious at all times to have my communications fairly criticised by those who enjoy better opportunities than myself for examining the working process, though few bestow more labour or thought on the acquisition of practical information.

The objection of "A. B.," if I understand him, to a toothed wheel for circular division is, "*because of the friction of the screw wearing the teeth of the wheel*," and to such an extent, as would, in a short time, greatly injure, if not totally destroy, the exact and correct working of this divisional apparatus. That the probable amount of friction, or, in other words, "wear and tear" of the parts, is greatly exaggerated by "A. B.," I have very little doubt; especially when the surface over which this friction is distributed, is taken into account. Thus, a six-inch centre-lathe would admit a wheel eleven inches diameter, rather more than thirty-three inches circumference. This, as a precautionary measure, might be cast in gun-metal—that is, an alloy of copper and tin, in the relative proportions of twelve to one—and the endless screw—one with *four* threads, would be quite sufficient to work the wheel—should be of cast steel, hardened and drawn down to a spring temper, for the same reason. In this case, the parts in contact would continually change position; and, when it is considered that the necessity of circular division is not of very frequent occurrence, I think all these circumstances, taken together, must convince "A. B." that his objection is untenable. So far, theory, and, I apprehend, reasoning from analogy, practice is equally conclusive; as it must, I imagine, have escaped the recollection of "A. B." that the movements of pinions and toothed wheels, combined in watch and clock-work—not to mention other mechanical appliances—have never been found to vary materially in their performance, within certain limits, from the cause stated by your correspondent, and for this plain reason, the aggregate of "wear and tear" is spread over a large surface, and, therefore, so minutely divided with respect to any individual point, as scarcely to be appreciable. Friction, in its origin and functions, is, unfortunately, but imperfectly understood, either by the philosopher or the mechanic; it is the true *opprobrium* of science: yet, if we cannot altogether remove, we may control, this retarding force by separating, as it were, its energies, and thus human ingenuity renders it comparatively harmless.

I could readily find a multiplicity of apt illustrations of this fact, but will quote one only, taken from a description of a theodolite,* constructed by the late Mr. James Allen:—The circular ring of this instrument is divided into half-degrees, and its edge racked or cut into as many—viz. 720 teeth, and worked by a tangent screw, one revolution of which moves the theodolite half-a-degree. A micrometer, on the head of the tangent-screw, is divided into thirty equal parts around it, which give minutes; and these being again subdivided into four, making 120 in all, give quarters of minutes.

It is to be observed, in this theodolite, that instead of reading off the divisions by a nonius or vernier, as usual, they are read by means of the micrometer; so that both the racked edge of the circular ring, and the tangent-screw working therein, would certainly be subject to ten times a greater amount of friction, than the dividing wheel of a lathe. Moreover, a theodolite is a very delicate instrument, which is required to perform the nicest and most accurate work; yet, with all these difficulties to encounter, it is presumed the tangent-screw was found sufficiently correct; nor does it appear that either the screw or the racked-edge, suffered any detrimental change from friction; otherwise the Society of Arts would not have rewarded the inventer, nor recommended the use of tangent-screws under similar circumstances.

Your obedient servant,

AN AMATEUR MECHANIC.

Aberedwy, April 5th, 1842.

ROTARY ENGINES.

To the Editor of the Penny Mechanic and Chemist.

SIR,—Your correspondent, "W. W.," who sent a drawing and short description of a rotary engine to your Magazine of the 19th of March, will much oblige me by informing me, on what authority, or on the strength of what experiments he states, that an engine of that construction will not do near so much work with the same quantity of steam as a beam-engine. The engine he describes, appears very similar to "Craig's rotary engine," for which, I believe, a patent has been obtained, and

* "Transactions of Society of Arts," vol. xxxiv.; Gill's "Technical Repository," vol. vii., p. 370—372.

which has been constructed up to thirty-horse power. I am decidedly of opinion, though it is an opinion founded only on theory, that an engine of this kind, if properly constructed, would be at least equal, if not superior in power, to the beam-engines now in use, with a very great saving of expense in their construction.

It is a very prevalent idea, that, by letting the steam escape through orifices, there must necessarily be an immense waste of power; I shall, therefore, state my idea of the principle on which it works, as briefly as possible.

Each arm is made to revolve, by the resistance to the pressure of the steam being removed; by the orifice on one side of the extremity of the arm, and the pressure on the other side, being thus not counteracted by an equal and opposite pressure, a revolving motion is caused in a direction opposite the orifice. The power with which it revolves, will be equal to the pressure of the steam upon a surface equal to the area of the orifice; and thus every cubic inch of steam which escapes, exerts a power exactly proportioned to its elasticity and consequent rapidity of motion, by leaving an equal pressure to exert itself, unbalanced by any pressure on the opposite side. If any of your readers have an accurate statement of the quantity of work done by one of these engines, they would much oblige by communicating it through your Magazine.

I remain yours, &c.,

A. W.

PERCUSSION WATCH-BALANCES.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I would beg to remark, in reply to "T. Bilbrough," that the place of the point of percussion in watch-balances, must vary with the weight of the rim; for if it stood at one-third the radius in a flat balance, yet a balance of exactly the same weight and size with a round rim, having the weight principally thrown on the extern, would have its point of percussion at a very different place. I very much question whether, practically, this could be exactly ascertained; as every balance varies, in some particular, either in the thickness of the arms, breadth or thickness of the rim, size of the socket, &c.; so that, to ascertain the point correctly, each balance must be separately tried. An approximation to the truth might be attained, but I strongly suspect that, in nine cases out of ten, breakage of pivots, &c., does not arise from striking the bankings, but from the weight of the balance being suddenly and violently disturbed by a blow or jerk.

I remain yours, &c.,

W. H.

THE GENERAL RECIPE BOOK.

A very fine Method for Marbling Paper.—The paper must first be prepared, that it may more easily retain the colours. This is performed by wetting the paper with a sponge dipped in roch-alum water, then letting it dry. When the sheets are prepared, have a pan full of water, and, with a large long-handled paint-brush, take off one colour, and shake it in the water; take off another, and do the same, till you have taken off all the colours you intend to have on your paper. Each of these colours falls to the bottom of the water; but take, with a similar brush as at first, a mixture of bullock's gall and a solution of soap in water; then shake on the water all over its surface, and you will soon see all the colours rising up again and swimming on the top of the water, each separately, as you put them; then lay the sheet of paper on it, give it a turn, and take it up again; wash and set it to dry, then burnish it, and it is finished.

To imitate Tortoise-shell with Horn.—Take one ounce of gold litharge, and half-an-ounce of quicklime; grind well together, and mix it to the consistence of pap, with a sufficient quantity of chamber-ley; put this on the horn, and three or four hours afterwards, it will be perfectly marked.

To Petrify Wood.—Take equal quantities of gem salt, roch alum, white vinegar, calx, and pebble-powder; mix these together, and ebullition will take place. If, after it is over, you throw into this liquor any porous matter, and leave it to soak for three, four, or five days, they will positively turn into petrifactions.

To Write in Silver.—Mix one ounce of the finest pewter or block tin, and two of quicksilver together, till both become fluid, then grind it with gum water, and write with it. The writing will then look as if done with silver.

To Soften Horn, so that it may be Cast in a Mould.—Make a strong ley with equal quantities of pearlashes and quicklime; rasp your horns, and put them in that ley; they will soon turn into a pap; then put into this pap whatever colour you like, and cast it in your mould. To

harden it afterwards, boil it in water of alum and saltpetre first, and afterwards in nut oil.

To Soften Metals.—Take saltpetre and camphor, equal parts. Dissolve them in a ley made with two parts of oak-wood ashes and one of quicklime; pass this solution through filtering paper, and evaporate it over a slow fire in a glass vessel; there results a borax, which, if thrown in metals while in fusion, softens them perfectly.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, April 20, J. Scoffern, Esq., on Poisons and their Antidotes. Friday, April 22, R. King, Esq., A History of the Esquimaux. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Tuesday, April 19, Election of Officers. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, April 21, E. W. Elton, Esq., on the Genius of Shakspeare. At eight o'clock.

QUERIES.

I shall feel greatly obliged for plain directions how to rack the edge of a circular plate of brass, so as to be worked by a tangent screw?

AN AMATEUR MECHANIC.

The Elizabethan twist. How is this particular kind of screw to be executed in the lathe? The best composition for taking impressions from plaster casts, &c., for the electrotype? I have used stearine, spermaceti, and wax; but in taking impressions from large casts, the composition I have been lately using, contracts and splits in all directions when cold. The method of remedying this evil, will greatly oblige

G. STARKEY.

How to make solder for zinc? P. T.

ANSWERS TO QUERIES.

"W. H." In reply to his query inserted in No. 75 of the PENNY MECHANIC, I beg to inform him, that Mr. Ibbetson has published what he calls "A Brief Description of his Geometric Chuck," which can be purchased at Holtzapffel and Co.'s, 64, Charing Cross, or at Mr. Weale's Architectural Library, 66, High Holborn; the price is 5*s*. or 6*s*. If he will be so good as to send me a sketch and description of the chuck he has invented, I may be able to save him some trouble, as I have a mass of information, printed and MS., on lathe chucks of every description—such as universal, elliptic, lever, eccentric, compound eccentric, straight line, &c., as well as geometric. If "W. H." is the same party to whom I am indebted for some suggestions on lathe-collars, and to whom I stand pledged to publish in the PENNY MECHANIC, a description of a lathe I have just completed, I avail myself of this opportunity to inform him, that I have not forgotten my promise; but, hitherto, indisposition, and a multiplicity of literary occupations, have quite prevented me making the necessary drawings. I hope to be enabled to do this in a week or two. The Editor of the PENNY MECHANIC will direct any letter "W. H." may wish to address to AN AMATEUR MECHANIC.

"J. H. L." will find a very full account of Turkey-red dyeing in Smith's "Panorama of Science and Art;" also, I think, in Hebert's "Engineer's and Mechanic's Encyclopædia," and in Dr. Ure's "Dictionary of the Arts and Manufactures."

"L. V." can buy the proper metal for organ pipes at any type founders, the old type being ready mixed in the right proportions. The cost is about 18*s*. per cwt. This he must melt, and run into sheets on a flat stone or slate table, covered with a piece of canvass. The sheets must be then planed smooth. All organ-builders run their own metal into sheets; consequently, the only persons of whom the sheets can be bought, are organ-builders. Zinc is not fit for pipes, being too brittle, difficult to work, and almost impossible to use in the small pipes. Pipes made of zinc would only be different in tone, from the necessary imperfections in the work. The lips could not be so delicately adjusted, the nicking not so regular, and the pipes more liable to come unsoldered, than if made of proper materials; and, lastly, in using the cone to tune them, the pipes would be apt to split down. Dulciana pipes ought to be made of metal. Should, however, "L. V." determine to make them of wood, they must be open at top; the following will enable him to construct the proper scale:—Middle C, 24 inches long, $1\frac{3}{8}$ inches deep, and one-sixth less in breadth; or, if cylindrical, for metal, $1\frac{1}{8}$ inch in diameter. The reeds are not usually made by organ-builders, but the following may enable "L. V." to construct a scale:—The effective part for an A reed, should be $1\frac{3}{10}$ inches long, and the width of the hole about one-eighth of an inch, or rather more. The reeds must be made about half-an-inch longer than the effective part, to allow for the part thrust into the pipe. The distance between the wire and the end is effective. The octave above should be equal to two-thirds of the lower octave, both in width and length. The octave below, one-half more. Key-making being a distinct business, I am unable to give any information about the cheapest place to buy the ivory for the keys. A set of second-hand piano-forte keys would be the cheapest and least troublesome. G. S.

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

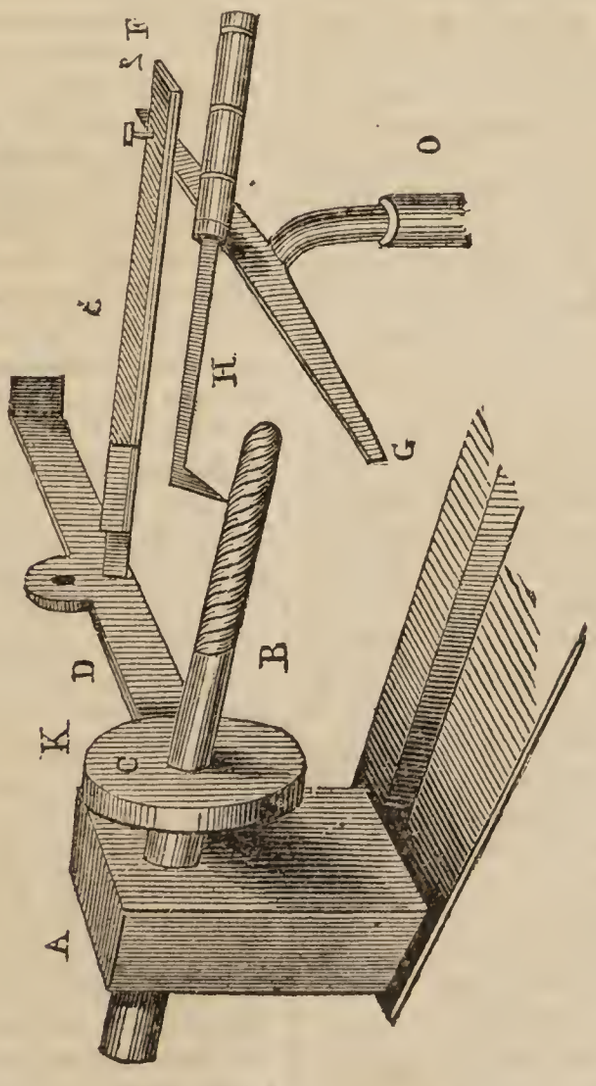
AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. **78**, THIRD SERIES. | SATURDAY, APRIL 23, 1842. | No. 326, OLD SERIES.

CUTTING SCREWS IN THE LATHE.

FIG. 10.



Vol. VIII.—No. 19.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ON CUTTING SCREWS IN THE LATHE.

(See Engraving, front page.)

No. IV.

24.* THE attention of scientific men has, of late years, been directed to the alteration and improvement of that extensive class of machinery denominated TOOLS; amongst which, the lathe stands pre-eminent, as one of the most useful and important, whether we regard it in its almost universal application, or the fidelity and accuracy of its performance. We owe to Mr. S. Lukens, an eminent American engineer, a very ingenious method of obtaining the spiral thread of a screw, which, although it depends, and is founded, on a well-known principle, yet the mode suggested for connecting and reversing the circular motion of the wheels, is, undoubtedly, novel, and possesses considerable merit. The description is, unfortunately, confused, and the more difficult to comprehend, as it is not accompanied by engravings; notwithstanding this drawback, we deem it worthy attention, and, accordingly, present it to our readers. "Several of our engineers," observes Mr. Lukens, "in the neighbourhood of the Metropolis and elsewhere, are in the habit of cutting original screws from a pattern screw, by means of expensive machinery adapted to the purpose, whereas the same may be effected in a very economical way.

"Those who are possessed of a lathe with a slide-rest, may convert the screw of that rest into a guide or pattern-screw, whereby to cut original right and left-threaded screws of various inclination and diameter, in the following simple manner:—The screw of the slide-rest has, generally, a square, formed at one or both ends of it, to carry a winch or handle. If the screw have only one square, it will be necessary to have another formed at its opposite end, upon which a square socket can be secured by a binding screw; this socket is united with one of the forks of Dr. Hooke's universal joint, formed of two such forks, with screws passing through their extremities, and having conical points, which enter into four holes, drilled at equal distances around an iron ball or sphere; the two forks being thus affixed at right angles to each other, as is usual in this description of universal joint. The stem of the second fork is elongated, and has a neck or pivot at its opposite end, which works in a cleft pivot-hole, made in a standard, attached to a cylindrical stem, and which can be fitted into the pillar of the ordinary lathe-rest, and secured by a set screw. Upon the exterior end of this stem, beyond the neck or pivot, toothed wheels or pinions, as the case may require, must be fitted and bound tight by a screw and nut; likewise into or upon the nose of the lathe-mandrel, a chuck must be screwed, intended to carry other toothed wheels or pinions to gear with those first mentioned; this chuck may have either a square central hole, or a steel conical point, screwed into it, to support one end of the work, the other being met by the centre of the moveable puppet. Things being thus disposed, a suitable screw-tool is then to be properly secured to the carriage of the slide-rest, and brought to act upon the cylinder on which the required screw is to be cut (in the manner already described in paragraphs 16 and 21).

"It is evident, that by the disparity in the proportions of the toothed wheels, the tool will be carried along faster or slower, so as to produce either coarser or finer-threaded screws, than the original or main screw of the slide-rest, or one similar to it, although of a different diameter, if the driving and driven wheels be equal. The universal joint is here necessary to accommodate the change of motion from a right line to any angle less than a right-angle.

"Should left-hand-threaded screws be required, then an intermediate wheel or pinion, to reverse the motion, must be affixed to the standard, and be brought to gear with the other wheels or pinions."*

25. It is both curious and instructive to trace the progress of inventive genius. How often do we find a discovery or an improvement on some known branch of industrial manufacture, simultaneously developed by two individuals, each of whom is entirely ignorant of the pursuits of the other. A few months since, a correspondent ("C. S., Jun.") submitted to our judgment a method for cutting screws in a lathe, which he imagined to be original; the plan, although ingenious, is nothing more than a repetition of Maudslay's, but the mechanism by which the wheels are connected, is very similar to Lukens'.

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* The paragraph immediately following 21, p. 123, No. 75, should have been numbered 22, and 22 should have been 23; also, that numbered 10, p. 122, should have been 16.

* "Technical Repository," vol. xi., p. 305—7. It is singular that Mr. Gill should have inserted Mr Lukens' communication, as a *new* and *original* mode of cutting screws; whereas he ought, as a practical man, to have known, that the principle had been employed nearly a quarter of a century previously at Manchester and elsewhere.

Fig. 8 shows the arms working on a joint, and

Fig. 8.

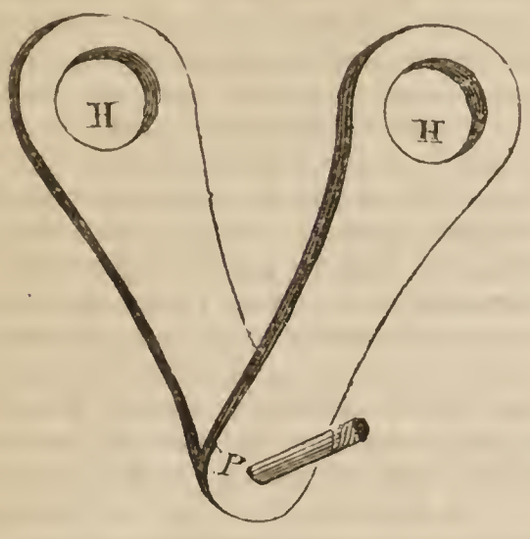


Fig. 9.

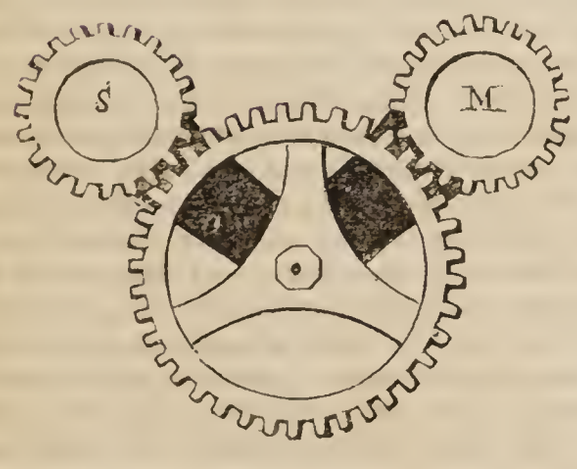


Fig. 9, the same, with the toothed wheels in gear, the arrangement of which is as follows:—Two flat pieces of metal, of the form shown in fig. 8, are connected at one end by a pin, P, so as to admit of a free angular movement upon and around this centre; a small toothed wheel is fixed on the nose of the mandrel, and this wheel has a projecting ridge, which fits one of the holes, H, fig. 8; another toothed wheel, of similar diameter, is, in like manner, fitted to the other hole, H; a larger wheel is placed on the centre-pin, P, and there secured by a nut. These three wheels are shown in connexion in fig. 9, and, as the arms of the apparatus are articulated at the centre of the larger wheel, the rest or support for the tool can be placed at any requisite distance from the centre of motion, so as to admit of work of almost any diameter; because, however far apart the centres, S and M, fig. 9, may be separated from each other, they will still retain the same relative distance from the centre of the larger wheel. This method requires a rest of peculiar construction, which is similar to, and has nearly the same effect as, the lower portion of the common slide-rest, the carriage being removed. In this rest, "G. S, Jun." proposes that the main screw shall serve both for a guide and a support to the tool, consequently, many such screws would be required. We consider this the most objectionable part of the plan, and have, therefore, omitted it. We may, however, remark, that one end of the main screw of this rest takes into one of the small wheels, and the nose of the mandrel, in like manner, the other; the larger wheel on the centre, P, gearing with both, and thus performing the duty of an intermediate wheel. The mechanical operation of this train of wheels is, obviously, too clear, to require any farther explanation at our hands.

26. We have now described and illustrated those mechanical principles, by which the helix or spiral thread of a screw may be traced on any cylindrical body, whilst revolving in a lathe. There are, however, other mechanical contrivances which produce the same effect; some of these are merely adjuncts to the lathe, others act independently of it; the requisite circular motion being communicated by other means. Such may be considered as exclusively screw-cutting engines, and not calculated for general work.

27. Mr. J. H. Ibbetson suggests a very convenient mode of cutting an accurate screw in a lathe, which, as it is likely to prove advantageous to many readers of the Penny Mechanic, we shall describe, especially as Mr. Ibbetson's publication* is expensive, and, therefore, out of the reach of most working men. The compound eccentric chuck, invented by this distinguished amateur, requires *two* screws of corresponding pitch; "in making them, every possible care must be taken to secure them against being, in the least, what is called *drunken*. I worked out these screws," continues the ingenious author, "in the following manner in the athe, with the screw-stock and dies, which I have found to be a very effectual way of making a good and correct screw: Having procured two pieces of round bar steel, of suitable diameter, I filed them up to the exact length required, and having centre-pointed them at each end, these pieces were then chucked between two centres, and turned down in the lathe, in

* "Specimens in Eccentric Circular Turning; with a Description of the Compound Eccentric Chuck, constructed by the Author." 8vo.

the usual way, to the proper size to form the screw. The screw-dies being then placed in the screw-stock, one of the pieces of steel prepared for the screw, as just mentioned, was put between the dies, and again chucked in the lathe, between two centres. The lathe being turned round, the die-stock and dies were caused to traverse and form a screw-thread, from one end of the steel piece to the other; and by continually working the dies backwards and forwards in this way—using plenty of oil—and screwing up the dies by little and little, as occasion served, the screw was completed. Throughout the process of making the screw, the die-stock must be kept firm and steady in both hands, and be caused to traverse at *right angles* with the screw that is being made. If the die-stock be allowed, in any part of its progress, to incline to one side or other of the screw-piece, the screw will, in that part, be imperfect—will partake of the defect called drunkenness."*

28. Very superior to, and much more simple than, the traversing mandrel, is the traversing chuck, invented by Mr. Robert Healy,† of Dublin; it differs altogether in detail from, but observes the same principle as, the former: like it, however, it is better calculated for cutting screws on wood or ivory than on metal; consequently, its utility being circumscribed, it has never, to the best of our knowledge, come into general use. The novelty and ingenuity displayed in the arrangement of its parts, and the facility of their construction, claim at our hands a full and particular description.

29. On the mandrel of the lathe, A, fig. 10, (see engraving in front page), is screwed the chuck, B, to which may be affixed the common lathe chuck, as K; on the outside of this chuck, B, is turned a screw, which is fitted to an inside screw, worked in the circular block, C, from which extends an arm, D, as long as may be found necessary for the purpose of permitting another arm, E, to slide up and down it; a piece of iron must be screwed to the circular block, C, of such a length as to be capable of moving in a groove cut in the puppet, or otherwise adapted to it. This piece of iron should be regular in shape, and well fitted to the groove; it is intended to prevent the block, C, from turning round, but to allow it only a steady rectilinear motion. The rest, G F O, must not stand, as usual, parallel to the work, in cutting an outside screw, but at right angles, as when an inside screw is to be cut, in order that the farther arm of the rest, F, may be joined to the end of the second or intermediate arm, E. It is necessary that this arm, E, be capable of fastening firmly, the first arm, D, to any part of the rest, G F; it must also have a joint at each end to admit, in a horizontal plane, its free play. Thus, as the lathe turns to or from us, the arms must traverse forward or backward, which gives a similar motion to the tool, H—that is, held steadily, or fixed by a screw on the farther arm, F, of the rest—and thus a screw may be cut with a single-point tool. It is scarcely necessary to mention, that the motion of the arms must be quite regular and uniform, as the slightest joggling would entirely destroy the perfection of the work. If the centre of the rest be drawn nearer to us, and, by that means, the tool brought closer to the intermediate arm, E, then a thread of a much coarser pitch will be produced; for, as the rest, turning within its socket—the set screw which fixes it in the pillar being, in this operation, always withdrawn—moves on a centre, the farther the tool is removed from this centre, the greater will be the radius of the circle described, and, consequently, the coarser or wider will be the pitch of the screw; and, *vice versâ*, the nearer the tool approaches the centre, the smaller will be the radius of the circle, and thus the thread will be finer.

Should the intermediate arm, E, be connected with the nearer arm of the rest, G, and the tool supported on the farther one, F, then a left-hand thread will be cut, the pitch of which will vary according to the distance at which the tool is placed between the centre and the extreme end; for, as the lathe turns to us, the arms receive a forward motion, except the farther arm, F, of the rest, which receives a backward motion; and, as the tool meets the material, so it describes a screw with a left-hand thread.

If the rest were to make a right angle with the work at the commencement of the process, and gradually to approach, so

* Idem, pp. 49 and 50. This arrangement is obviously the reverse of that described in paragraph 12; as a temporary expedient, it may answer very well, but the success of the operation is too dependent on manual dexterity; it presents, however, a singular example of the principle which must be observed in cutting screws in a lathe; the rectilinear and circular motion being here given to the stock and dies, by the hands of the workman, which supply the place, and perform the duty of the slide-rest, with its chasing or screw-cutting tool.

† Communicated by the inventer, and first inserted in "The Philosophical Magazine."

as, at last, to become parallel to it when the screw was finished, an approximation would take place from a larger to a smaller thread, or *vice versâ;* but this is impossible, from the connexion of the arms. Now let the traversing arm, D, lie in the centre of the screw, B, on which it plays, and let the rest make a right angle with the cylinder on which we intend to cut the screw; the rest may traverse thirty degrees on either side of the right angle; which will not cause any sensible approximation in the thread, but will admit a motion sufficiently extensive for all practical purposes. It is manifest that, as the method answers for a screw of a few threads, that is sufficient to enable us to extend it to almost any required length; and this may be accomplished in three ways:—

1. At the commencement of the operation, the rest stands at right angles to the work in the lathe, and, by its describing an arch of a few degrees, a short screw is cut; then by bringing back the rest to its original angle—the right angle—and sliding forward the single-point tool to the thread last cut, we may proceed to any length, by repeating the same process.

2. When one or two threads of a screw are described, by making use of a common screw-tool, the most unskilful hand will be able to continue the lead.

3. If a side tool with several teeth, instead of the single point, be used, a screw of any length may be easily cut, the rest describing the usual arch.

DESCRIPTIVE GEOLOGY.

(Continued from p. 127.)

OSSIFEROUS CAVES *(continued)*.

THE remains of the animals principally found in these caves, belong to the elephant, rhinoceros, hippopotamus, bear, tiger, horse, ox. deer, wolf, hyena, fox, glutton, weasel, hare, or rabbit, water-rat, mouse, &c.; with fragments of the skeletons of ravens, pigeons, larks, ducks, &c.

The following extinct species of mammalia were discovered in the caves of Wellington Valley and Buree, Australia, by Major T. L. Mitchell ("Three Expeditions into the interior of Eastern Australia")—dasyurus, lamiarius, phalangista, hypsiprymmus, macropus (3), halmaturus, phascolomys, diprotodon.

Among the bones found in the caves of Germany, are many in a condition which must have resulted from accident or disease. In some there has been a formation of new bony matter to repair fractures; in others there is anchylosis, or adhesion of the joints from inflammation; while in some, the effects of caries, or decay of the bones, the result of tedious and painful diseases, are apparent. Others have a light and spongy character, and are very fragile, which must have arisen from a want of energy in the nutritive system, in consequence of a scrofulous affection. (Prof. Walther "On the Antiquities of Diseases of Bones.")

Human bones and works of art—such as coarse pottery, bracelets of bronze, and sepulchral urns—have been found in caves, both in France and Germany; a circumstance perfectly natural, since we are well aware that mankind, in a rude state, have been in the habit of living in caves; and traces of their having inhabited recesses, which had previously been the retreat of wild animals, were, therefore, to be expected. But as bones of extinct animals occurred with them, it was rashly assumed that they were coeval with each other; more accurate observation has, however, shown, that the human remains were introduced at a subsequent period. We have historical proof, that the early inhabitants of Europe often resided, or sought shelter in natural caves. Thus Florus relates, that Cæsar ordered the inhabitants of Aquitania to be enclosed in the caverns to which they had retired. Many tribes of the Celtic race occupied these subterranean retreats, not only as a refuge in time of war, but also for shelter from cold; as magazines for their corn, and for the produce of the chase; and as places of concealment for the animals which they had domesticated. The bones of such of these people as perished, or were buried in these caverns, would become blended with the mud, gravel, and debris of the animals already entombed; and a stalagmatical paste would, in some places, be formed by the infiltration of water—as at Bize—and would thus cement the whole into solid aggregates. We should, therefore, expect to find masses of stone, containing bones of the bear and other extinct species, with human bones, fragments of pottery, and terrestrial shells, and bones of animals of modern times. Such are the contents of numerous caves, and the above explanation points out the mode in which these accumulations have taken place. ("Memoir, by M. Desnoyer.")

TUNING THE ORGAN.

Organ pipes are always made a trifle longer, consequently, flatter than necessary, to allow of their being cut down to the note required; they still want a more delicate adjustment, to make them perfectly in tune; this is accomplished in various ways, according to the description of pipe; all of which methods have been explained in a previous paper.

The *principal* is the stop from which all the other stops in an organ are tuned; consequently, any fault in tuning that, will cause the whole of the others to be wrong also; it is, therefore, most essentially requisite that it should be carefully done, and repeatedly tried, before tuning any other stop.

The note is to be tuned first, to the pitch of the C tuning-fork, then the octave below. If there be the slightest beating or throbbing sound heard when sounding them both together, the note being tuned is not perfect; and, to ascertain whether it requires to be sharper or flatter, place the tip of the finger over the aperture at the top of the pipe, so as partially to close it—this flattens the sound; then if the beating be remedied, it shows that the pipe requires flattening, which is done by pressing the edges at top a little inwards, by means of the tuning cone before described. If, on the contrary, the beating be made worse, or the sound altogether discordant, by the finger being placed on the top, it proves that the note requires to be sharper; and it is to be made so, by pressing the edges outwards, by the point of the cone being pressed into the pipe.

The following diagram shows the notes that form the foundation, and numbered in the order in which they are to be tuned. Every octave must be made quite perfect; but every fifth a trifle less sharp than perfect.

B flat.	B.	C.	C sharp.	D.	E flat.	E.	F.	F sharp.	G.	G sharp.	A.
16.	10.	2	13.	5.	18.	8.	15.	11	3.	14.	6.

B flat.	B.	C.	C sharp.	D.	E flat.	E.
17.	9.	1.	12.	4.	19.	7.

The following may assist the novice in tuning:—

C (tuning-fork) ..... C, an octave below..... G, 5th above.
D, another 5th above .. D, an octave below..... A, 5th above.
E, another 5th above .. E, an octave below..... B, 5th above.
B, octave below ..... F sharp, 5th above .... C sharp, 5th above.
C sharp, octave below.. G sharp, 5th above.

Then begin again at the original:—

C (tuning-fork) ..... F, 5th below ..... B flat, 5th below.
B flat, octave above .. E flat, 5th below .. E flat, octave above.

There will then be an octave and a half tuned; the rest must be tuned in octaves to these. These nineteen notes require the greatest attention, as they form the foundation; and these, once in perfect tune, the rest is simple enough.

The diapasons are to be tuned, every note, an octave below the same note in the principal, as, also, the following:—Bassoon, cremona, dulciana, hautboy, trumpet, vox humana. The double diapason and trombone, an octave below the diapasons, or two octaves below the principal.

The clarion and the flute in unison with the principal, and the fifteenth an octave above. The twelfth is to be tuned a third below the fifteenth.

The sesquialtera, cornet, and mixture, can be used only in large organs, as they are compound stops—that is, composed of from three to six ranks of open metal pipes, tuned in thirds, fifths, and octaves, to the diapasons; so that every key being touched, produces a common chord.

In conclusion, I wish to make it perfectly understood, that the most trifling beating or throbbing must not be left; and the notes are only in tune when the two, held down together, produce one harmonious and steady sound.

G. S., Jun.

ON GLASS-BLOWING.

In this sketch, the formation of chemical vessels will be more particularly considered; so that the student in chemistry may, after a little practice, be enabled to form various articles, which will be found exceedingly useful and economical in the experiments in which he may be, at different times, engaged, besides affording many hours of amusement and gratification. The first and most necessary article is

The Blowpipe.

There are three kinds of blowpipe, which may be made available in glass-blowing—the mouth-blowpipe, the water-pressure, and the double-bellows. The mouth-blowpipe, which is well known, can only be used when glass tubes of small diameter and thin substance are to be operated upon; and for this purpose, when used with a spirit-lamp, it is very convenient. Of the water-pressure blowpipe, there are two descriptions—one in which air is forced by the mouth into a tin or earthen vessel, having a partition down its centre, dividing it into two equal parts, which partition descends to within half-an-inch of the bottom of the vessel; the whole apparatus is air-tight; a mouth-piece, with a valve opening inwards, and a jet for the exit of the air that is to propel the flame, are inserted in the top of one of the parts before mentioned; the mouth-piece screws off, that the vessel may be half filled with water. On blowing through the mouth-piece, the water, in one division, is forced up above its level into the other, and, by its weight, tends to press the air from the jet in a regular stream. The second description of this blowpipe is, in the most essential parts, exactly like the first, but differs, in this respect—that, instead of being supplied with air by the mouth of the operator, a pair of common bellows are used, to the nozzle of which a pipe is fixed, having at its extremity a valve, which opens inwards. This pipe, instead of the mouth-piece, is fixed into the vessel before described, and which may be made considerably larger. The bellows are worked, by means of a treadle, by the foot of the blower; so that a good supply of air is constantly kept up. The double-bellows form decidedly the most useful blowpipe. They are so common, that a description would be superfluous; suffice it to say, that a sufficient weight should be placed on the upper board, in order to insure a continued and powerful current. This, from the make and manner in which it is fixed, is termed the table-blowpipe, and is the one used by most glass-blowers.

The Jets or Nozzles.

It is important that the orifices of these should be perfectly round and smooth. The size of the orifice must have a relation to the size of the wick of the lamp that is used. The most convenient diameter for the orifice, will be mentioned when the lamp is described. They are made of different materials; brass is the best, although some are made of tin plate, but are very inferior to the brass ones, and are more liable to lose their shape. Glass jets are convenient, because they can be made at any time by the glass-blower himself; but they have the disadvantage of being easily melted; this may be, in some measure, remedied, by making the points of very thick glass, and keeping them some distance from the flame: they are also less liable to get dirty, and more easily cleaned than the metallic ones.

The Lamp.

There are various forms of lamps used, of which the following is not excelled by any, either in cleanliness or convenience:—It is made of tin plate, of an oval shape, seven inches long, and one inch and a half deep; it has, also, a shallow tray of the same form, but rather larger, in which it stands; this is to catch any of the oil that may overflow. The wick-holder is also of an oval shape, and the size one inch and a half long by three-quarters of an inch broad. The wick is formed of clean cotton yarn, and the "droppings of sweet oil" is the combustible used. The cotton should be quite clean and dry, and the oil should not be allowed to stand in the lamp; but when not in use, the lamp should be emptied of its contents, and put in a place protected from dust. To make the lamp complete, it is advisable to have a hood of tin plate placed over it, which condenses the smoke, and protects the eyes of the operator from the heat and glare of the flame. A wick of the size mentioned, should rise about three-quarters of an inch—never more than an inch—above the surface of the oil. The diameter of the orifice of the jet to be used with this wick, is the twelfth of an inch.

Glass Tubes.

These are the only materials that the chemical student will find it necessary to use in fabricating his various utensils. They must be selected of different sizes and thickness, and ought to be straight

and perfectly cylindrical, both inside and out. It is indispensable, when the tubes are to have spherical bulbs blown upon them, that they should be of equal thickness in every part. The best hard white glass tubes are made in Bohemia, the best soft ones in France; both of these sorts are free from lead, which is a great recommendation: it is difficult in England to get any but flint glass. Before heating the tubes, it is necessary that they should be quite dry and clean, and cut to a proper length, according to the article to be made.

Having described the apparatus and materials used in glass-blowing, the next thing to be considered, is the method of proceeding, in order to fabricate the desired articles.

POLYTECHNIC INSTITUTION.

THE largest electric machine in the world is now in operation at this place, and is well worth the attention of the curious scientific visiters. The diameter of the glass plate is seven feet, the globular prime conductor being nearly four feet in diameter. So great is the resistance of the plate against the rubbers, that the steam-engine is employed to cause its rotations. When the battery is fully charged, a spark can be driven with ease through a thick book, which would almost, if not quite, resist the perforation of a bullet. One of the experiments shown is, the repeatedly discharging a current of electric fluid through a long glass tube, having within numerous metallic points, each of which, simultaneously and instantaneously gives out a spark with a cracking noise: the rapid union of these scintillæ resembles lightning. An artificial aurora borealis is also produced. The great quantity of electric power generated by this instrument, affords a most extended field for experimental philosophy, and opens a prospect of very interesting discovery.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, April 27, J. Scoffern, Esq., on Poisons and their Antidotes. Friday, April 29, R. King, Esq., History of the Esquimaux. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street—Thursday, April 28, Mr. Traice, on the Genius and Dramatic Writings of Sheridan. At half-past eight.

Philosophical Institution, Bemmont Square, Mile End.—Thursday, April 28, J. S. Buckingham, Esq., on America and the Americans. At eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, April 25, Mr. Baker, on Sulphur and its Compounds. At a quarter past eight o'clock.

QUERIES.

1. Where can I see or purchase M'Farlane's calculating planispheres. 2. Can any correspondent give an account of Mr. Fox Talbot's new method of taking the Daguerreotype on paper, similar to what is done on the plated copper? 3. I observe that Mr. Beard, the patentee of the photographic portraits, advertises that they can be done in colours; I presume the colours are added afterwards; what is the process?

G. S., Jun.

If any of your readers should be in want of a small steam-engine boiler, I have one to dispose of very cheap; it is two feet long by one foot four diameter. It is very strong.

S. J. HEGGS.

The best mode of bleaching shell-lac? S.

TO CORRESPONDENTS.

A Subscriber.—*We really never heard of such a strange phenomenon. The best way to be satisfied as to the truth of it, will be to try the experiment.*

W. T.—*Copper is melted in a furnace with an intense heat. Sulphate of copper may be bought wholesale, of any drysalter or wholesale druggist, at about 36s. per cwt.*

C. J. N. *will find the recipe in No. 51 of the last volume, page 408, strengthen the hair better than anything that can be used.*

B. *would find it much more expensive to manufacture vinegar on so small a scale, than to purchase it. We think, also, that, being an exciseable article, it would be prohibited.*

H. R. *will find every requisite information, if he will take the trouble to peruse a course of articles on steel, now being inserted in the* PENNY MECHANIC. *It commences with the first No. this year.*

W. W. C.—*The mahogany ought to have been perfectly freed from oil, before the polish was laid on. Turpentine may, perhaps, remove it; but it will require a great deal of elbow-grease to bring the polish up again.*

Charles *may purchase the size he requires at any respectable paper-stainers'. They call it white size. The black draught, so called by the Faculty, is merely an infusion of salts and senna, with the addition of a little manna and tincture of senna or cardamoms*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.
A MAGAZINE OF THE ARTS AND SCIENCES.

No. **79**, THIRD SERIES. | SATURDAY, APRIL 30, 1842. | No. 327, OLD SERIES.

HIGH-PRESSURE STEAM-CYLINDER.

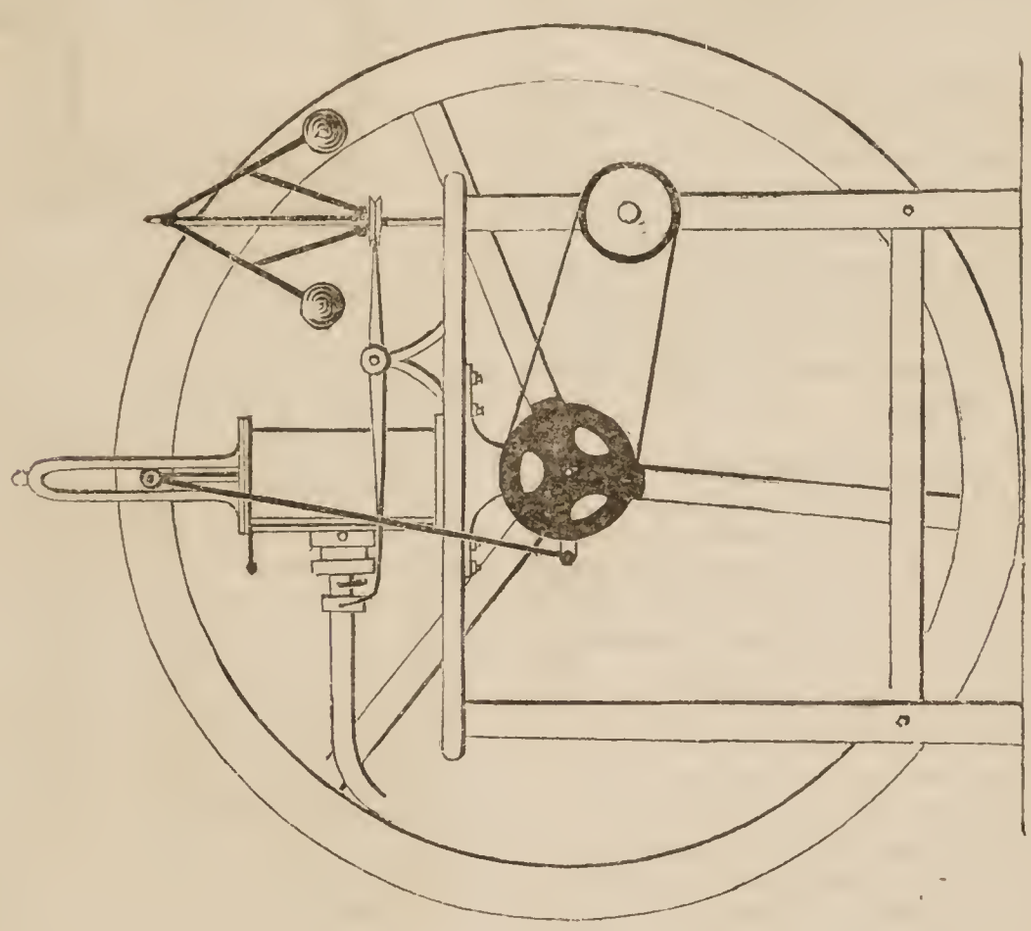


Fig. 2.

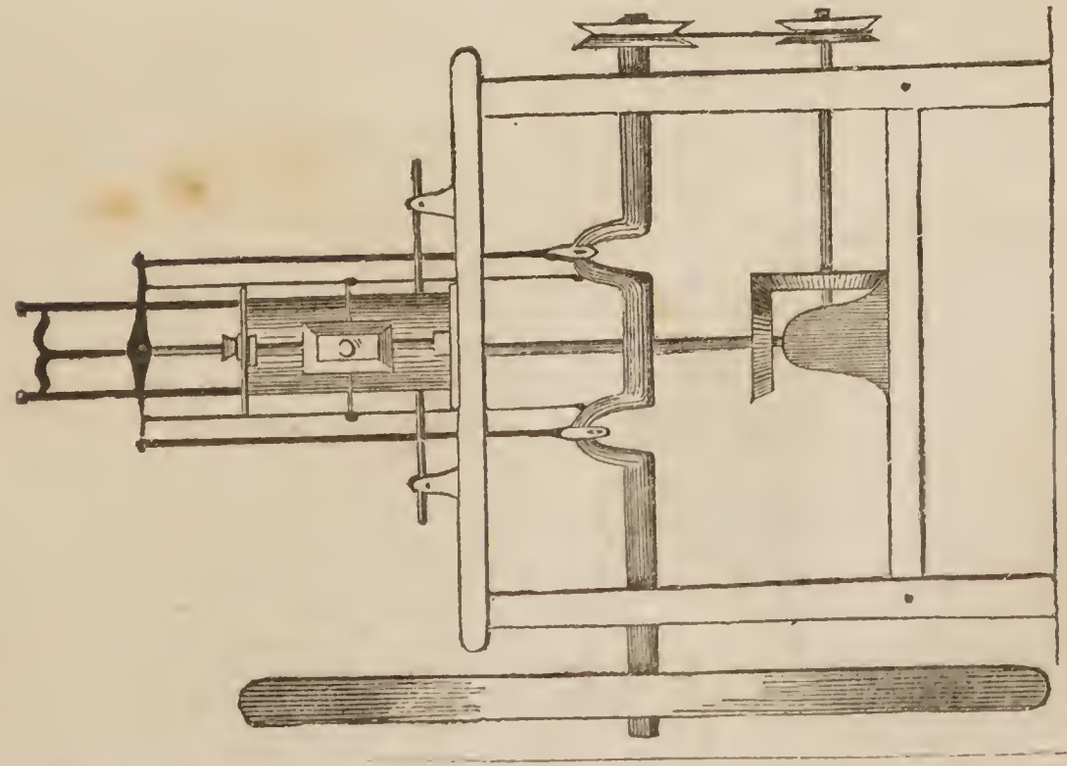


Fig. 1.

Vol VIII.—No. 20.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

HIGH-PRESSURE STEAM-CYLINDER, APPLICABLE TO LOCOMOTIVE AND OTHER ENGINES.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—The following is a description of a high-pressure steam-cylinder, applicable to locomotive and other engines, which, if you think worthy of insertion in your useful Magazine, is at your service.

With cylinders I am about to describe, the slide is worked in the same direction as the piston, by the lower port-hole of slide communicating with the upper hole of cylinder, and the upper port-hole of slide communicating with the lower part of cylinder; insuring, thereby, a gain of power, as well as a diminution of friction, on account of the use of the eccentric not being required.

Those high-pressure engines that are worked by the eccentric, where the slide is continually in action with the piston, have but half the power they are calculated at, exclusive of friction. The defect lies in the working of the slide, the eccentric giving the slide a gradual motion over the port-holes. The steam has its full power above and below the piston, when the slide arrives at the centre of port-holes, as shown at fig. 6. With the cylinders of my construction, the slide is not continually in action, but is suddenly shifted by the piston, when it arrives near the top or bottom of the cylinder; so that the steam exerts its full power on the piston in every part of the cylinder.

Fig. 3.

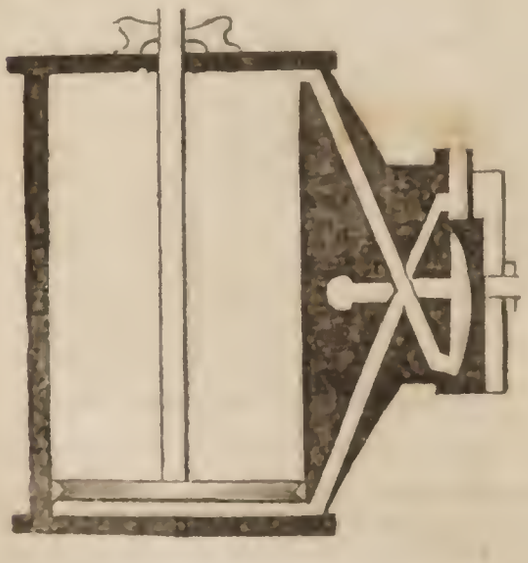


Fig. 4.

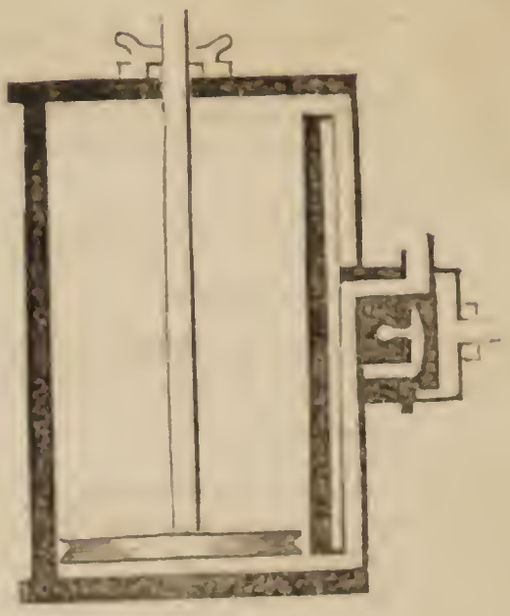


Fig. 5.

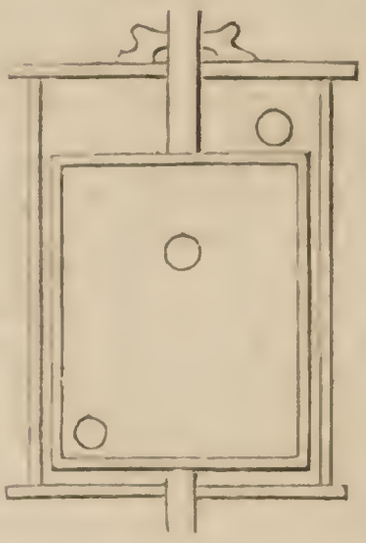


Fig. 6.

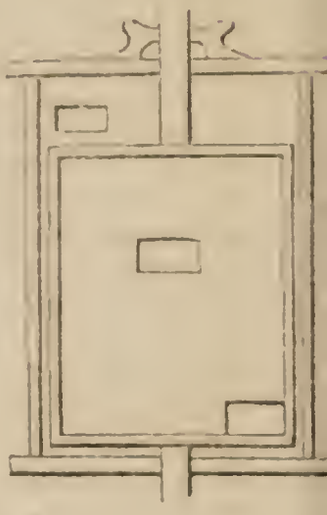
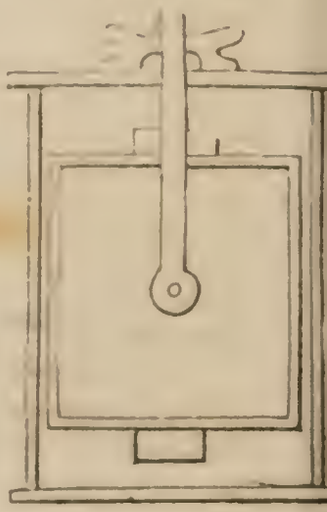


Fig. 7.

Fig. 8.



Description of the Engravings.

Fig. 1, side view of the engine, with method of working the slide.

Fig. 2, front view of the engine, with method of working ditto.

Figs. 3 and 4 are cylinders, with slides attached.

Figs. 5 and 6 are slides: fig. 5, with round port-holes; fig. 6, with oblong ditto.

Fig. 7 is the slide, with escape and lower port-hole covered.

Fig. 8, the slide in ordinary use, with upper and lower port-holes half uncovered.

I remain yours, &c.,

T. R. Bilbrough.

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS, &c.

(Continued from page 140.)

Every mechanic is sensible of the value of *good* tools, as necessary appliances to the performance of his work more quickly, with less exertion, and more accurately, than can be done with inferior ones; yet how few are able to answer this apparently simple question—What constitutes this quality, denominated *goodness*—that is, keenness and durability of the cutting parts, combined with tenacity or toughness? Take, for instance, two chisels for turning iron, both made of cast steel, and from the hands of the same maker, which, although similar in outward appearance, the one may be absolutely worthless, and the other equally valuable! Surely if, during the process of fabrication, these tools had been treated with similar care, the one, all things being alike, would correspond with the other. Experience shows the fallacy of this mode of reasoning. Nearly every turner of metal makes his tools, and for this obvious reason—he cannot depend on those he purchases. The smith who forges, hardens, and tempers these tools, rarely uses them; he labours merely to produce a certain number in a given time, and, if they please the eye, his object is attained. The truth is, this class of workmen are neither prepared by education* for their avocation, nor are sufficient wages allowed to remunerate for that care and faithfulness which are absolutely required.

It is important to remember "that steel, being composed of iron and carbon, the latter substance becomes *volatile* at a high temperature. When too strongly heated—that is to say, when the carbon is volatilized, the steel loses its nature and its valuable properties, and becomes iron; consequently, instruments made of it, no longer possess that keenness of edge which we wish to preserve. It is extremely difficult, in a forge with a naked fire, to avoid exceeding the proper degree of heat, especially in small or thin pieces; but in a *muffle*, we may always be certain of attaining and preserving the proper temperature—the article not being covered with the coals, as it is in the common forge. Pit coal is commonly used by smiths, and this article, at the high temperature to which it is carried for steel, furnishes, also, sulphurous particles, which, uniting with the steel, neutralize it, and render it brittle. This has been proved by the analysis of a cast-steel tool, which did not contain sulphur in its original state, but, when forged, the presence of a considerable quantity was detected.

"Pit coal may, nevertheless, be employed for the first operation; but, when the steel is drawn down to a certain point, the work should invariably be finished in a muffle.*

"The actual process of forging steel, should be conducted as follows:—The workman heats the bar until it just begins to redden, but *far below a cherry-red;* he forges it till it becomes cold, and, even after it is in this state, he continues to hammer it, in order to make the grain of the steel close and fine, and to prepare it the better for tempering."†

We will now suppose the tool to be formed, but still attached to the bar, from which it must be separated, and heated in the muffle to finish it. "A good workman rarely gives it more than two heats; which is of great importance, as a greater number is apt to injure the steel, and alter its quality.

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* In this respect, the English mechanic is far behind the continental artizan; a fact proved beyond the possibility of doubt, by Parliamentary papers lately published. The intelligence, uniform sobriety, and general good conduct of the foreigner, offer a painful contrast to the wretched, demoralized, gin-drinking inhabitants of our great manufacturing towns. This is not exactly the place, nor have we leisure, to speculate on the cause of this national evil; yet we cannot avoid hazarding one remark—where the working community is deprived of proper and requisite sustenance, by a system of deliberate class-legislation, the members of that community are induced to seek, in exciting liquors, that relief which wholesome food ought to supply.

* A piece of gun-barrel, one end being closed, is an excellent substitute for the muffle; inasmuch, that it is more durable, and less liable to crack or open, than either a cast-iron or earthen muffle.

† Steel, after it ceases to be hot, yields very little under the hammer; but if annealed, as recommended in a former paper (see page 139), it will be found to stretch considerably in hammering, even when cold.

"The forged tool or other article, being brought nearly to the form required, by the hammer, is allowed to cool completely in the ashes, without coming at all in contact with the air; it is then finished with the file, ready for hardening. In this operation, the muffle is still more necessary; the material is heated until it has attained a cherry-red—and this colour must not be exceeded—then plunged into cold clean water: the colder the water is, the better will be the hardening. The tool is to be gently moved about in the water, until it is entirely cold, and afterwards held over the forge-fire for a few moments, to warm it, before it is finally exposed to the cold air; lest, by a sudden change, it might crack, which frequently happens with thin and delicate articles, when this precaution has been neglected.

"The steel is now tried with a fine file, in order to ascertain that it is properly hardened; it is then brightened, previously to being tempered, for the purpose of distinguishing what colours the surface exhibits from the action of the heat, in order to give to it a proper degree of strength and elasticity, according to the nature of the tool, and the purpose for which it is intended. When Huntsman's* cast steel is used, it must be brought to a *lemon yellow* heat; but all steel does not require the same degree of colour; this must be regulated according to the different qualities of the metal. We know that it passes through all the following shades:—1st, *Yellow*, which also has three distinct shades—*straw-colour*, *canary-colour*, and *lemon-yellow*; 2nd, *Orange*; 3rd, *Red*; 4th, *Violet*; 5th, *Blue*; 6th, *Grey*. When steel arrives at this last colour, however little the heat may be increased, it reddens and returns to its first state—that is, as it was before being hardened and tempered. It is not so with all steel; some requires a higher, some a lower degree of heat, so as to insure a harder or softer temper, varying with the character of the metal; as the fact is indisputable, that each quality of steel requires a different manipulation appropriate to its nature.

"The knowledge of making a proper choice of steel, and of avoiding to injure it while working it out, is of material consequence to the tool-maker; likewise, that he forge it dexterously; that he harden and temper it carefully, always plunging it into the coldest water he can procure, and never giving to the steel *more heat than is absolutely necessary:* in this consists all the secret of hardening and tempering. He who desires to earn a name for his work, should patiently study the quality of steel, in order to treat it accordingly, and diligently note those apparently trivial indications, which escape the eye of an unpractised observer; but, above all, he must not suppose that *no one can teach him anything concerning steel.*"

This knowledge is more easily acquired than is generally supposed, provided the mind be disabused of prejudice, and the inquiry conducted on the broad principle of truth. With this feeling, it shall now be our endeavour to render the facts before the reader subservient to a practical use, applied more especially, 1st, to the construction of tools, and, 2nd, to the formation of the cutting edge—that is, the angle of inclination which has been found most suitable for the purpose.

It has been ascertained by experiment, that if a portion of a tool be hardened in the usual manner, that part which immediately adjoins the soft metal—which is, necessarily, as soft as steel can be rendered—possesses peculiar excellence far surpassing any other portion of the hardened metal; and this has been ingeniously accounted for, by supposing that *there* it had received the exact degree of heat.

"This circumstance deserves more attention than may be generally imagined; as we can command that part of the steel which is of the best quality, by carefully heating the point of the tool, and quenching it in water; we then, with a file, try which part of it is hard, and which soft, and choose that which most nearly approaches the soft portion, to form the bevel or cutting edge of the tool.

"Farther, if we previously heat the steel to a degree just short of the hardening* point, and quench it in water, we shall find that it is quite soft, and is susceptible of spreading or yielding under the hammer; we can, in this state, close the pores, and condense it effectually. We

* This individual was the discoverer and original patentee of the process by which steel is cast, and thereby refined. For many years this description of steel bore his name, and the brand is still, I believe, in the market. One thing is certain, Huntsman's cast steel was very superior to that now commonly sold as a material for edge-tools; it has never been equalled, except, perhaps, by that manufactured by P. Stubs, of Warrington, expressly for his fine and justly celebrated files.

* "*Dictionnaire Technologique;*" art. "Coutelerie. See also, "*Technical Repository,*" vol. vii., pages 131—142, 176, 241—244.

must then, as already described, again heat, and quench it in water, and form it into a suitable shape for the tool; and, provided the steel be of good quality, we shall thus have availed ourselves of every precaution necessary to insure perfection." Such being the case, it must, obviously, be the interest of every mechanic to avail himself of instructions which do not require long use to master, but, on the contrary, are easily comprehended as readily practised, and promise complete success.

"If steel be over-heated, as it too often is, in the ordinary methods of working it, it is quite impossible to obtain a satisfactory result; and, therefore, in proving every fresh bar, especially of cast steel, we should invariably ascertain the proper or lowest heat,* at which it will harden; and endeavour, as much as possible, in forging, not to exceed that limit; we shall then preserve the valuable properties of the steel in the highest degree; and, although it requires more time and manual labour to work steel at a lower heat than usual, yet this expenditure is more than counterbalanced by the superior and lasting qualities of the tools thus produced.

"Some tools require to be tempered after being hardened; some do not. As a general rule, it may be stated that, if they will stand *without* tempering, so much the better; but this process is the *chef d'œuvre* of the art, and not to be acquired without long and patient observation; inasmuch, that, if the precise limit of heat be passed, we must then have recourse to tempering.

"In all cases where it is desired to harden tools of any considerable length, we must contrive so that the necessary heat shall be equally and uniformly diffused; as this cannot be done with any certainty in an open forge-fire, we employ a muffle, or an iron tube, or piece of a gun-barrel closed at one end; in either of these the tool is placed, and, by this means, a uniform heat is imparted to the steel, especially if we make what is termed "a hollow fire" over it, which materially assists the operation. This tube has also the good effect of preserving the steel heated in it from coming in contact with the *bituminous coal* of which the fires of forges are generally made; it being well known that the sulphurous gas disengaged during the combustion of this description of fuel, is most prejudicial to steel. In working cast steel, *coke* or *charcoal* * is to be preferred to *pit coal*; but in some parts of the country, neither of these is to be obtained; consequently, it is fortunate that we have an easy and unexpensive mode of protecting steel from the injurious action of a fuel in common use.

* This, of course, depends on the character of the steel; as the heat which *would be* fit for blistered or sheer steel, would be totally unfit for cast steel, and *vice versa*.

* Since this was in type, our attention has been directed by a friend to the "Penny Cyclopædia," Art. "Steel," part cix. Among other wild theories, we find it there stated, that "the *higher* the temperature to which steel is raised, and the more sudden the cooling, the greater is the hardness; thus, when immersed in mercury, the hardness is greatest, on account of the good conducting power of the metal, and its consequent ready abstraction of heat. After this comes acidulated water, salt water, common water, and, lastly, oily or fatty bodies." We had purposely omitted mercury, because its high price precluded its use among workmen—and for them only we write—but we much question whether the author of this most extraordinary farrago, ever attempted either to harden or temper a tool, or to use one when so prepared. It is lamentable to discover such palpable incompetence, and this is by no means a solitary instance; had it been so, we should have passed it by in silence, exhibited in a publication professing to be written for the working classes, and boldly claiming support as the encyclopædia of the workman.

* In confirmation of this remark, we may add, that Mr. Fox, of Derby, a celebrated engineer and lathe-maker, invariably uses charcoal, in a small portable forge; and, also, that he coats the steel articles with a thin layer of loam mixed with water, by dipping them into the mixture, and drying them before putting them into the fire, in order to avoid oxidizing or scaling the steel; the loam instantly flies off the surface of the articles when plunged into water to harden them, and, therefore, does not in the least impede that operation. A similar process appears to be commonly adopted by the machinists of the United States. See Gill's "*Technological Repository*," vol iv., pages 161—6.

ON GLASS-BLOWING.

(Continued from page 152.)

THE tubes ought to be presented horizontally to the flame, and a general rule to be observed is, to keep continually turning them, so that every part of the tube may in turn be equally and properly heated; and as melted glass necessarily tends to descend, this is the only method of preventing the tube from becoming deformed. When you heat a tube near the middle, the movement of the two hands must be uniform and simultaneous, or it will be twisted and spoiled. If a tube have thick sides, it must not be suddenly plunged

into the flame, or the unequal expansion of the particles of the glass will cause it to crack; but it must be first placed in the current of hot air, at some distance from the point of the flame, and, being continually turned, must be brought nearer and nearer, until in the flame itself, the maximum of temperature will be found at about two-thirds of the whole length of the flame from the jet. You can judge of the consistence of the tubes under operation, as much by the feel as by the look of the glass. The degree of heat necessary to be applied, depends on the objects for which the glass is destined. As soon as the glass begins to feel soft at a brownish-red heat, you are at the temperature most favourable to good bending; but to blow a bulb, the glass must be completely melted, and subjected to a full-white heat. Every glass instrument must be annealed—that is to say, gradually withdrawn from the hot part of the flame to that which is cooler, and from thence out of the flame altogether, still keeping it in the current of hot air, until, at last, it is to be taken out of that also. This must be most particularly attended to, if the glass be thick. When laid aside, it should not be allowed to touch anything that is cold or wet, but it should be placed on pieces of cork until quite cool.

The fundamental operations in glass-blowing may be reduced to ten:—Cutting, bordering, widening, drawing out, choking, sealing, blowing, piercing, bending, and soldering.

Cutting.

Tubes may be cut either with the Lancashire file, or a thin plate of cast steel, having its edge roughened by rubbing on a sandstone or a sanded board. A notch is first made half round the tube, the hands grasping the tube; the two thumbs are placed against the notch at the opposite side of it; the two ends are then pulled asunder, in the same manner that a stick is broken across the knee. Another method is, to apply to the glass an iron rod, made red-hot, which will cause it to crack; on the rod being pressed on, and carried round the tube, the crack will follow it. Hard-steel tools—such as drills, rasps, files—cut glass with extraordinary facility, when thoroughly whetted with a solution of camphor in oil of turpentine.

Bordering.

Certain tubes—such as test-tubes, dropping-tubes, &c.—require to be bordered at their mouths; this may be done in the following manner:—After having heated the mouth of the tube all round, until it is quite soft, insert an iron rod into it, and gradually press the edges out, still keeping the tube in the flame, and continually turning it. Having done this, and while the edges are yet soft, press an iron plate against them, which will flatten and reduce them to a proper form. It should be remembered, that there is no danger of the glass, when in a softened state, cracking, upon the application of the cold iron.

Widening.

The tube must be first made soft, then, being withdrawn from the flame, the sides are to be pressed out with an iron rod, having a conical point; it is then to be again heated, and the rod again applied, until the proper diameter is obtained.

Drawing Out.

A tube may be drawn out, either in the middle, the side, or the end. If the operation is to be performed in the middle, the tube is supported with the right hand below, and the left above; it is then kept in the jet until of a cherry-red heat all round; then remove it from the flame, and, still turning it, separate the hands from each other, and draw the tube in a straight line. If at the side, that particular side must be fused, a piece of waste tube applied to it, which will adhere, and the point may be drawn out by means of this piece. If it be the end that is to be drawn out, heat the extremity until it is in a state of fusion; then, withdrawing it from the flame, immediately seize it with a pair of pliers, and, at the same time, separate the hands: the more quickly the hands are separated, the more abrupt the end will be: or it may be done in the following manner:—A piece of spare tube is to be fused on to the original one; then, by directing the point of the flame a short distance above the end, it may be drawn out by means of the auxiliary tube, which, in this case, supplies the place of the pliers. A red heat, or cherry-red heat, is best adapted to this operation.

Choking.

By choking, is not meant the closing or stopping of the tube—which will be described in the next operation—but simply the diminution of the bore. It is done by heating a zone of the tube, which, when softened, is either pulled out or pushed up, according as a hollow or ridge outside is desired to be made.

Sealing.

If the sides of the glass be thin, and the diameter small, it will be sufficient to expose the end to be sealed to the flame of the lamp. No instrument will be necessary; for, when softened, it will sink of itself, in consequence of the rotary motion given to it, towards the axis of the tube, and become rounded. But should the case be different, the tube of large diameter, and the sides thick, then soften the end, and, with a pair of pliers, mould the sides gradually, by bringing the circumference of the edges towards the centre, until it is of good form and perfectly rounded, keeping it in the flame during the whole operation. In order that the bottoms may be of good shape, blow gently into the tube with the mouth, while the bottom is still hot. If the bottom is to be flat, while soft, press it against an iron plate; if rounded like the bottom of a bottle, the air must be sucked out, or the bottom pressed in by an iron rod.

W. W. W.

BLUEING OF STEEL.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I must again beg leave to say a few words relative to the blue colour which appears on steel, when heated to a certain temperature.

It appears that "Mr. Bilbrough" allows that it is an oxide which covers the surface of the steel; and the question is, with him, Where does oxygen come from? I say, with every chemist who has said anything on the subject—from the atmosphere; and which I will demonstrate in the sequel, by a very decisive experiment. "Mr. Bilbrough" states, that he has blued steel in an exhausted receiver of an air-pump, and in one which he constructed himself for the express purpose, and can produce specimens to prove it—a fact which I do not doubt for a moment. I would recommend "Mr. Bilbrough" not to show the said specimens to any one about to purchase an air-pump of his construction. The best air-pump yet constructed, where the valves are lifted by the pump, never produced a vacuum; and, I think, "Mr. Bilbrough" should have given a description of his pump, *pro tem.*, and the height which the mercury stood in the guage at the time the steel was within, and how he introduced the steel and heated it, without, at the same time, admitting air; that the readers of his article might judge for themselves, whether such a mode were unexceptionable or not.

The following experiment proves—if a proof were wanted—that the oxygen is derived alone from the air, and that, unless oxygen be in contact with the surface, no blue or other colour is, or ever was, produced by heating it. Heat mercury to its boiling point, and introduce beneath its surface about an inch of the end of a main spring, with the blue previously removed by sand-paper; the steel, in a few seconds, is heated to the temperature necessary for blueing, and that part of it which projects above the surface of the mercury, acquires the usual dark-blue colour for a quarter of an inch, beyond which, as may be expected, it is too cold. Remove the mercury from the fire when this appearance has taken place, and when nearly cold, but not before, take the steel out, and it will appear as bright as it did before it was put in—that is, every part of it that at no time, while hot, came above the surface of the mercury; while that portion which was just above the mercury, and in contact with the air, was of the usual colour of watch-springs. Any liquid may be used which does not act on steel, and which can be heated to the necessary temperature. Fusible metal may be used, and the steel removed, when it begins to solidify. Lead does not answer well, for this obvious reason—that the steel cannot easily be removed after the lead becomes solid. This experiment answers every condition necessary; it heats the steel to the temperature required, in a few seconds, and perfectly excludes the air, and will be quite satisfactory, I am persuaded.

I remain yours, &c.,

T. Reeves.

NEW PROCESS OF MANUFACTURING BRICKS, TILES, ARCHITECTURAL MOULDINGS, &c.

At the annual meeting of the Liverpool Polytechnic Society, on Friday, the secretary (C. F. Salt, Esq.) read a communication from Mr. R. Prosser, C. E., of Birmingham, on his patent process of manufacturing bricks, tiles, architectural mouldings, &c. The invention is applicable to any article that can be produced under a press. In the ordinary mode of making bricks, the clay is prepared by suitable machinery, and mixed with water, to temper it and reduce it to a plastic state, fit for brick-making. All these laborious processes used to be performed by the hand, in the open air; but, latterly, much manual labour has been superseded

by horse and steam power, in the operations of grinding the wet clay between rollers, and tempering it in a machine called a pug-mill, which is an iron cylinder set upright, in the axis of which an upright shaft revolves. Several knives are attached to this shaft in a spiral manner. As the upright shaft revolves, the clay thrown in at the top is wet, and kneaded, and forced through an aperture in the bottom of the pug-mill, and, by this process, it becomes tempered, ready for the moulder. Large quantities of water are used in the tempering process, in order to make the clay soft enough to be forced into the moulds; and this water must be got rid of, by a slow drying process, before the bricks can be burned. Each thousand bricks, when ready for the kiln, weigh about half-a-ton less than when they are first moulded. This half-ton of water has to be evaporated before the bricks can be burned. The novelty of Mr. Prosser's process consists in the clay being dried, ground to powder, and submitted to pressure in metallic moulds, until the particles cohere together. As there is no water in combination with the clay, no drying process is necessary; consequently, the articles made by this method, are ready to be fired or burned as soon as they leave the machine. Owing to the great pressure required to cause the particles of clay to cohere together, the articles made by this process have greater density than those made in the ordinary way; they are also less porous, and not subject to decay by wet or frost. In addition to these advantages, any architectural device may be impressed upon the clay, which, when burnt, will retain all the sharpness of the original, however elaborately finished. By this process, bricks can be made in all weathers, and with greater economy than by any other plan known at present. The brick-press is worked by hydraulic pumps, giving about 300 tons pressure, thus producing the adhesion of cohesion. The machine delivers the bricks (four at a time in the present machine) ready at that instant for the kiln, requiring no exposure to the atmosphere to dry. The whole operation, from the time of putting the powdered clay into the machine to the delivery of the brick, occupies about half-a-minute. Machinery might readily be constructed to produce fifty bricks in a minute. This invention is likely to work a revolution in the style of buildings in this country; the most elaborate Gothic may be produced at no very great cost. The secretary exhibited a brick made by this process. It attracted much attention. The secretary also exhibited some specimens of buttons: they were truly elegant, and were very much admired. At the present time, about 5000 gross of buttons are made weekly at Messrs. Minton and Boyle's, at Stoke-upon-Trent. The demand for them is greater than can be supplied by the present number of presses.

Liverpool Standard.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, May 4, J. Scoffern, Esq., on Poisons and their Antidotes. Friday, May 6, H. W. Woolrych, Esq., on the Philosophy of Language. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, May 5, S. Preston, Esq., on Electricity, Galvanism, and Magnetism. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, May 5, J. S. Buckingham, Esq., on America and the Americans. At eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, May 2, Mr. Thomas Smith, on Geography. At a quarter-past eight o'clock.

QUERIES.

How to dye wool and stuff a marine blue, and how to make it a fast colour? H. B.

I have a very good pneumatic apparatus, equal to new, which I wish to dispose of for less than half its prime cost. It consists of an air-pump, ten inches high, with plate and receiver; a pair of hemispheres, guinea and feather experiment, lead-weights, fountain in a vacuum, hand-and-bladder glasses, and an apparatus for raising heavy weights by the external pressure of the atmosphere. May be seen any night after eight o'clock, at No. 10, Great James Street, Hoxton Old Town, Shoreditch. R. H.

The mode of preparing paper for calotype drawing; or, should the art not have been made public, where and at what price the composition used could be procured? C. J.

The composition of gold ink, and the proper quantities? Also, the composition of that paste which is used in cleaning white kid gloves? A. C. R

TO CORRESPONDENTS.

We are obliged to let several answers to queries and notices to correspondents, stand over till next week.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doubney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

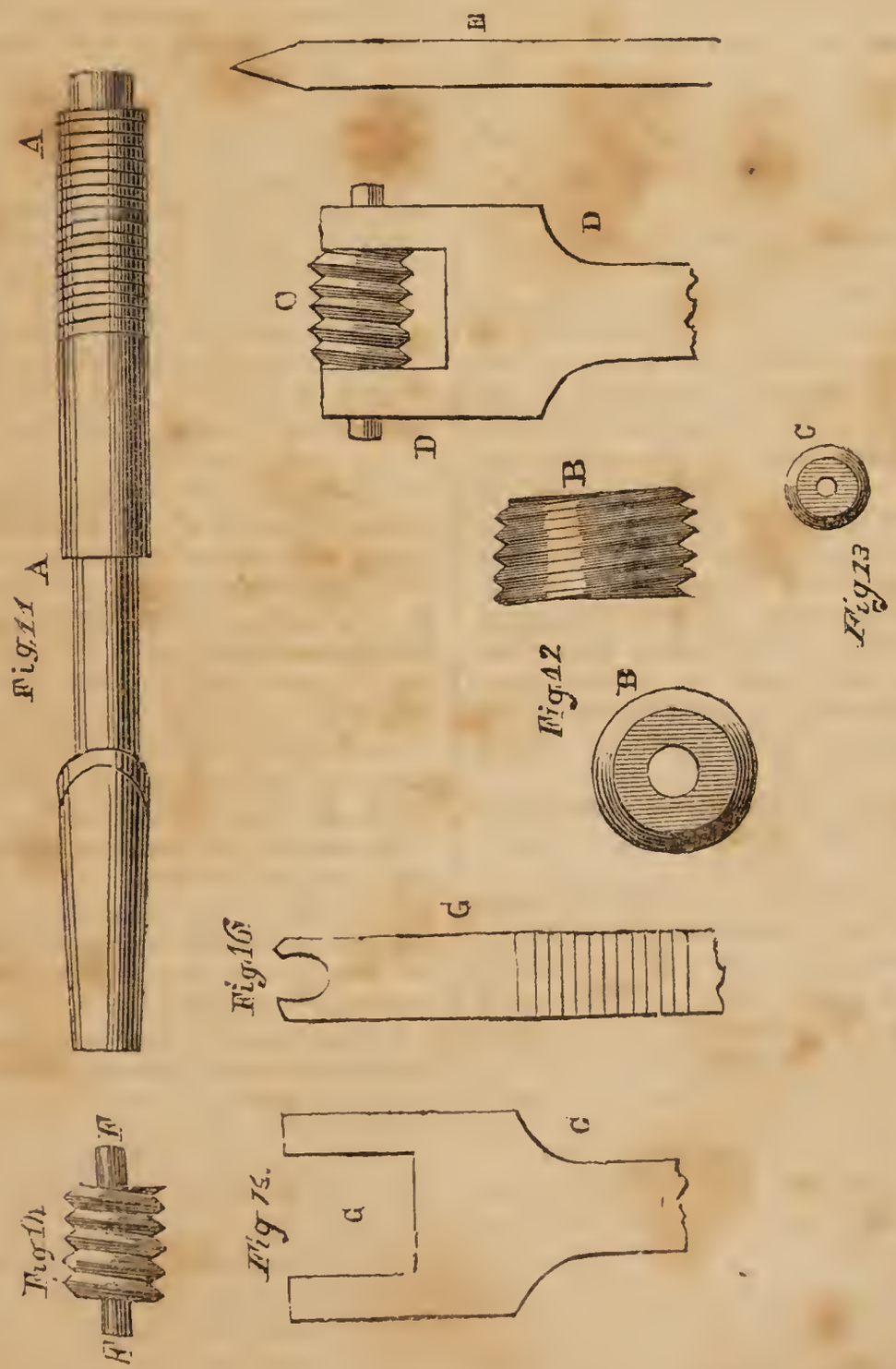
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. **80**, THIRD SERIES. | SATURDAY, MAY 7, 1842. | No. 328, OLD SERIES.

CUTTING SCREWS IN THE LATHE.



Vol. VIII.—No. 21.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney

ON CUTTING SCREWS IN THE LATHE.

(See Engraving, front page.)

No. V.

30. We have already adverted (par. 9, page 84) to the great expense Mr. Ramsden incurred in constructing apparatus to cut a screw sufficiently accurate for his dividing-engine; this, although ingenious, is exceedingly complicated; nor does it present any novelty, either in principle or detail. We, therefore, do not feel ourselves called upon to repeat that which is already before the public, and has been many times described in various scientific works.*

31. In the year 1823, the Society for the Encouragement of Arts, Manufactures, and Commerce,† awarded to Mr. G. Walsh, the silver Vulcan Medal, and ten guineas, for a method whereby a correct, or, as designated in the Transactions of the Society, an *original* screw may be obtained. The screw made by Mr. Walsh, when examined by a micrometer, appeared to be erroneous, to the amount of no more than $\frac{1}{250}$th of an inch in thirty-four threads; and, therefore, though not sufficiently accurate for astronomical purposes, it may, nevertheless, be advantageously applied to other uses. The ingenious simplicity of the apparatus by which the screw is made, not requiring the aid of a screw-engine, with guide-screw, wheel-work, slide-rest, &c., is a circumstance worthy of notice, as offering to the artisan of adequate skill, but contracted pecuniary means, facilities of good work, which, hitherto, have not been within his reach.

Fig. 11, A A, represents a cylinder of soft steel, which is to be cut into a screw.

The first step is, to turn a short cylinder of soft steel exactly double the diameter of the intended screw. This is to be fitted on an arbor in the lathe, and, by means of a common screw-tool of the required number of teeth, is to be cut into a double-threaded screw, and then to be hardened. Of this latter screw, B B, fig. 12, represents a lateral and a front view.

Another short cylinder of soft steel is then to be made of exactly the diameter of the intended screw; it is then to be fitted on a pin, and put into the frame, D D, fig. 11; in this situation it is to be pressed hard against the cylinder, B, fig. 12, whilst revolving in the lathe, until a good thread is raised on its surface. The thread, thus obtained, will be single, though taken from a double thread; because, during the process, it revolves in proportion to the larger cylinder, as two to one; it will also have a left-hand thread, because taken by impression from a right-hand one. After a few revolutions of the cylinder, C, fig. 13, the frame in which it is held, is to be turned upside down, and a similar number of revolutions is to be made with the frame in this position, by which alternation, the thread will be kept quite perpendicular to its axis; and the more the two cylinders are worked together, the more will the cylinder, C, be free from the errors of the first cylinder, B. Being completed, it is then to be hardened, and again put into the frame, D D. The cylinder, A A, being now put into a lathe, the screw, C C, is to be pressed hard against it, in the manner of a milling tool, beginning on the right hand; when it has made a sufficient impression or lead, it is to be shifted one thread towards the left hand; the following threads of the screw always working in the preceding impression, which serves as their guide. This is to be continued till the whole cylinder is impressed with the lead of a screw—as shown in fig. 11—which will, of course, be right handed, because the impressing screw is the contrary. The lead, thus obtained, is to be eased or cut deeper by a pointed tool, E E, and is then to be finished by the screw, C; taking care, as before directed, to reverse the frame, D D, from time to time.

To make a left-handed screw to suit a given right-handed one, tap a cylinder of steel in the same dies, and of the same diameter as the given screw, and turn each end down to a pivot, as F F, fig. 14; and harden it, drop it into the open frame, G G, fig. 15—of which fig. 16 is an end view—and work it hard against the prepared cylinder, exactly as already described for the original screw; by which means a left-handed lead will be obtained, which is to be deepened with the point-tool, and finished by the roller, F F, as before. When completed, this screw may be hardened, and left-handed dies tapped with it in the usual manner.

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* The reader may consult Mr. Ramsden's treatise on his dividing engine; also, Partington's *Cyclopædia of the Arts and Sciences*, vol. ii.; Nicholson's *Operative Mechanic and British Mechanist*, page 322.

† "Transactions," vol. xlii., pages 127—9.

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS, &c.

(Continued from p. 157.)

HITHERTO, so far as our researches have extended, neither the preparation of the steel, nor the form of tools employed in turning, planing, or otherwise shaping iron and the harder metals, has received that attention which the importance of the subject imperatively demands. With but one or two exceptions,* no attempt has been made to treat the subject on those plain and general principles, of which it is obviously capable, and, when so treated, then it may be fairly presumed to be intelligible, and, consequently, serviceable to that class of men to whom the use and management of such tools are, for the most part, intrusted. In fact, so much and so great practical value attaches to this inquiry, that not only the quality, but the quantity, of work produceable from turning-lathes and similar machinery, is dependent principally, if not entirely, on the skill of the operator, in carefully working the steel into shape; then, after hardening and tempering, in giving to his tools the proper form. There are, doubtless, many excellent workmen who, by a species of natural instinct, have acquired the art of giving to the tools either the *true* form, or so nearly have they approached the true principle, that, by preserving and repeating that form which experience has proved to be the best, they are enabled to produce the required result. But even with such, when a case occurs, which obliges them to deviate, in the least, from the "beaten track," they are then as much "at fault," as if they knew nothing about the matter. This arises from no other cause than ignorance of those *general principles* which would guide them, as well, 1st, in preparing the metal, as 2nd, in obtaining the true form for the cutting edge of the tool, however applied.

1. With regard to the preparation of steel, after having been forged into a suitable shape and hardened, it may be assumed that, as the pores of the metal are unavoidably opened by the action of heat necessary to induce hardness, any process which would tend to bring together or condense the molecules of the steel, must naturally increase its tenacity very materially.

In almost every instance, the quality of cast-steel tools may be greatly improved—even after being hardened and tempered—provided they are of sufficient substance to admit of being heated to a *spring temper*, or, in technical language, *blazed off;* as, at that heat, the steel is rendered capable of yielding to the blows of a hammer, and thus its texture becomes much closer and more dense, than as left from hardening.*

Under certain prescribed conditions, "Some cast-steel tools are susceptible of condensation, and their quality consequently improved, after being hardened and tempered, without being subsequently heated; a fact clearly demonstrated by the researches of the late Mr. Edmund Turrell, a celebrated engraver of mechanical subjects, who discovered that the Lancashire gravers sold at the toolshops, could be so much improved, as to cut with ease steel plates. This ingenious experimenter tempered a common graver to a *straw colour*, and found that, on laying the back of it upon a rounded anvil, he could, by a repetition of gentle blows given in quick succession with the cross-pane of a small and very hard cast-steel hammer, succeed in rounding or blunting the acute edge of the belly of it considerably; thus proving that it had undergone a great degree of condensation. Reasoning from analogy, Mr. Turrell concludes, that no beneficial impression can be produced beyond a certain limit, which he thinks is indicated by a sharp ringing sound following the blows, as the steel has then received the necessary condensation. The graver was then again tempered to a *straw colour*, and the edge ground to a proper shape, when it cut a steel plate—not decarbonized—readily, and retained a fine and durable edge. †

It must be evident, we think, to any person who reflects on the general me-

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* The most important contribution to our stock of knowledge on this subject, is a series of practical observations, communicated by Mr. James Nasmyth, of Manchester, as an appendix to the late edition of *Buchanan on Mill-work*, by George Rennie, Esq., C. E. To this treatise we are largely indebted; and we feel the greater pleasure in acknowledging the obligation, knowing the enlarged and liberal views of both the editor and the publisher; and we shall derive sincere gratification, should our humble efforts in any way conduce to make a work more generally known; deserving, as it does, to be carefully studied as a text-book by every machinist and tool-maker in the United Kingdom.

* By a similar process, Mr. George Walby produced trowels which were famous, and well known in the trade for their excellence and durability. See *Transactions of Society of Arts*, vol. xxii., page 335.

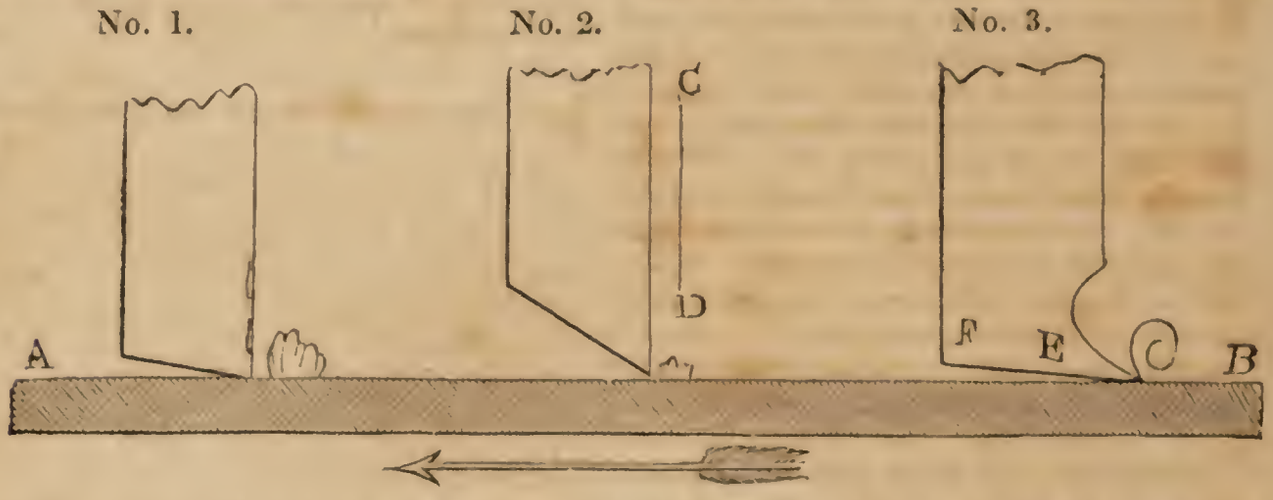
† See Gill's *Technical Repository*, vol. vii., page 295, for a more detailed account of the particulars.

thods of treating steel, that the more it is condensed by hammering, the more will the attraction of cohesion between the constituent particles be increased, and, consequently, the tenacity or toughness of the metal will be greatly promoted. To effect this object, some persons hammer the steel, when cold, for a considerable time before heating it, to harden, by immersion, in a suitable fluid; unfortunately, the operation of heat must, of necessity, destroy the good effect produced by previous cold hammering, and thereby neutralize, in a great measure, the advantages contemplated.

In every case where practicable, it is desirable to condense the steel by hammer-hardening, at the *tempering heat*, and to continue the process till the metal becomes cold. The teeth of narrow saws may be thus condensed, by carefully hammering the tops of them, which likewise has the good effect of *thickening* or spreading the blade laterally, and enables the saw to work more freely after the teeth have been again sharpened by the file, as usual, and to cut much harder metals than it was capable of doing previously. The edges of drills are, in like manner, susceptible of condensation; but if of small size, it is advisable to hammer the flat sides, and, when thus treated, they will be found in every respect essentially improved, both as respects durability of edge and power of perforating metals, which they were quite incapable of acting upon, in their merely hardened and tempered state.*

II. We shall now proceed to investigate what angle affords the best form for the cutting edge of tools.

Here the principal object for our consideration, is the direction in which we desire to cut or penetrate the metal. Suppose, therefore, the plane, A B, to be the surface of a block of iron from which we



propose to cut off shavings in the direction, A B, either by A B moving against the tool, or the reverse—namely, the tool moving against the block—for the action is identical in either case. Now if we were to employ such a tool as No. 1, we should find little or no penetrating quality in this form of the tool, which would not cut, but rub off or abrade the particles by sheer force. The reason of this is, that the edge is so very blunt or obtuse at the point of cutting, that, by their coming against it at right angles to its face, the whole motive force will be consumed in merely rubbing off, and not cutting away, the particles of metal.

Again, as regards No. 2, which certainly *appears* more like a tool that would cut, we shall find it inadequate to produce the desired object, and also encounter other evils. In this case we have no greater penetrating property in the direction, A B; for the force applied to the tool is in the same relative position in respect to the surface to be cut, as in the instance of No. 1—that is, it is at right angles to it—so that we gain no advantage here; and, what is far worse, we derive from this tool a penetrating quality, in a direction diametrically opposed to that which we desire—namely, in that represented by C D. Now in moving the surface, A B, against this tool, we should, on attempting to enforce a cut, find that its penetrating property, in the direction, C D, would immediately exhibit itself in a series of serrated, teeth-like marks, more or less deep, according to the strength of the cut and that of the tool, which, in all probability, would not preserve its point entire for a moment, but would be snapped off with little or no force; because the cross

* See farther, Gill's *Technical Repository*, vol. viii.; and *Technological Repository*, vol. iv., where the reader will find many valuable and important observations on improving tools by condensing, planishing, and burnishing the cutting edge, communicated by M. Perkins, Messrs. P. Keir, Mainwaring, and others.

section of metal at the *point* is scarcely measureable. This is the most common error in the formation of edge-tools—that is to say, because they *look* sharp, the workman is satisfied; forgetting, altogether, the direction in which the strain is to be applied, and, in consequence, not providing sufficient metal, as shown by a cross section, to meet the resistance of the strain.

If we examine the tool, No. 3, we shall find that all these requisites are supplied. In the first place, we have a high degree of acuteness in the direction of the cut—namely, A B; then, as regards strength *behind* the point, we have all the metal, from E to F, to afford adequate support; and this amount of strength, compared with No. 2, may be estimated by the distance, E F, being greater than C. Besides this important consideration, we have another advantage of great moment—namely, the entire absence of all tendency to chatter—to use a technical expression—or produce a jagged uneven face; F E, acting as a complete *stop*, to the risk of digging into the surface, which we are planing or turning: but this would inevitably happen with No. 2, supposing the point sufficiently tenacious to resist the force, which is very problematical. The character of the shaving indicates the cutting value of either of these tools, and is a fair estimate of the relative advantages of each. In Nos. 1 and 2, the particles removed are minute and disconnected; while in No. 3, they assume the shape of complete and continuous curls, as is manifest from the form of the tool.

In No. 1, therefore, we have strength, but no acuteness in either direction.

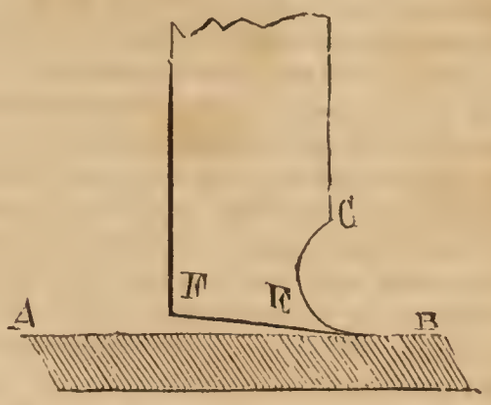
In No. 2, we have acuteness, undoubtedly, but in a direction quite opposite to that required, and a *total absence of strength.*

In No. 3, we have acuteness entirely in the direction needed, combined with the greatest amount of strength.

From these premises, founded, be it remembered, on actual practice, we deduce the following principle, which we believe to be invariable—namely, in forming and setting a tool intended to cut any substance whatever, we must so place it, that *its end shall form the least possible angle with the surface to be cut;* and, whatever degree of acuteness be deemed proper, let the keenness be communicated by hollowing out a portion, as E C, No. 4.

All, therefore, we have to observe is, to keep the base of the tool as nearly parallel to the plane of the material to be operated on, as possible, forming the acute or cutting edge, in the manner just described; and this is evidently the surface on which the shavings slide. The same

No. 4.



remark applies to turning tools, and, indeed, to every tool, from the smallest and most delicate-cutting instrument, up to the most enormous and ponderous tools used with lathes and planing machines of the largest dimensions.

PNEUMATICS.

No. IV.

EXPERIMENTS WITH THE AIR-PUMP.

AFTER the full description I gave in No. 77, of the air-pump, I will show how a number of interesting and important experiments may be performed by it, which will afford the most convincing and satisfactory proofs that can be given of the weight, elasticity, and other mechanical properties of the air; and, as many of your readers may not have opportunity either to perform, or witness the performances of, these experiments, I shall endeavour to make them as interesting as possible, by stating the important facts which they have been the means of making known to us.

Experiment 1.—To show the weight or pressure of the air, procure a Florence flask, whose contents are exactly known in cubic inches; let a small brass cap, with stop-cock, be nicely cemented to the mouth of the flask; screw the neck of the stop-cock into the hole of the pump-plate; then, having exhausted the air out of the flask, turn off the stop-cock, and unscrew it from the pump-plate. Having done this, let it be suspended at one end of a balance, and nicely counterpoised by weights at the other end; if we now turn on the stop-cock, the air will rush into the flask with an audible noise, during which time the flask will descend, and pull down that end of the beam. When the noise is over, put as many grains at the other end, as will restore the equilibrium; and they will show exactly the weight of the quantity of

air which has got into the flask and filled it. If the flask made use of, holds an exact quart, it will be found that seventeen grains will restore the equipoise of the balance, provided the mercury in the barometer stands at 29½ inches; which shows, that, when the air is at a mean density, a quart of it weighs seventeen grains. It weighs more when the mercury stands higher, and less when it stands lower.

Experiment 2.—Set a small glass vessel, open at both ends, over the hole of the pump-plate, and put your hand close upon the top of it; then, upon exhausting the air out of the glass, you will find your hand pressed down with a great weight upon it, so much so, that it will be difficult for you to remove your hand until the air is re-admitted into the glass; which air, by acting as strongly upward against the hand, as the external air acted in pressing it downwards, will release it from its confinement.

Experiment 3.—Having tied a piece of wet bladder over the top of the glass used in the last experiment, set it to dry, and then the bladder will be tight, like a drum; then place it, open end downwards, over the hole of the pump-plate, and begin to exhaust the air out of the glass. As the air is exhausting, its spring within the glass will be weakened, and give way to the pressure of the outward air on the bladder, which, as it is pressed down, will put on a spherical concave figure, which will grow deeper and deeper, until the strength of the bladder be overcome by the weight of air; and then it will break with a report as loud as a pistol.

Experiment 4.—Place a flat piece of glass (instead of the bladder, as in the last experiment) upon it, joined by a ring of wet leather being placed between them; upon pumping the air out of it, the pressure of the outward air upon the flat piece of glass will be so great, as to shatter it all to pieces.

G. Starkey,
Mineralogical Chemist.
Church Street, Shoreditch.

ON THE DUTY OF FUEL.

To the Editor of the Penny Mechanic and Chemist.

Sir,—It is well known that a considerable quantity of smoke that is perceived ascending from chimneys (particularly those in connexion with fires under steam-boilers), is carried away without all being consumed, and fulfilling all its duty. To remedy this loss of fuel, there was, till of recent date, but one way by which it could be occasioned—viz. the engine-man's constant attention to the fire, introducing small quantities of fuel, and at more frequent intervals, which is somewhat difficult to obtain.

"A patent has recently been granted to Mr. Williams (one of the directors of the City of Dublin Steam-Navigation Company), for a method of consuming the unburnt gases which escape from the grate, and are carried through the flues. This method consists in introducing into the flues, tubes placed in a vertical position; the lower ends of which are inserted in the bottom of the flue, and made to communicate with the ash-pit, and the upper ends of which are closed. The sides and tops of these flues are pierced with small holes, through which atmospheric air, drawn from the ash-pit, issues in jets. The oxygen supplied by this air, immediately combines with the carburetted hydrogen, which, having escaped from the furnace unburnt, is carried through the flues at a sufficient temperature to enter into combination with the oxygen admitted through holes in the tubes. A number of jets of flame thus proceeds from these holes, having an appearance similar to the flame of a gas lamp.

"It is evident that such tubes must be inefficient, unless they be placed in the flues so near the furnace, that the temperature of the unburnt gases shall be sufficiently high to produce their combustion."

G. E. Holt.

ADELAIDE GALLERY OF PRACTICAL SCIENCE.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I had the pleasure of visiting this Gallery one evening last week, and, if I may judge from the number of respectable people present, the evening's amusement provided here, has equal attraction with other places of a more alluring description. In order to form an idea of the kind of entertainment to be met with here of an evening, I will, by your permission, briefly describe a few of the principal objects which pleased me most. On reaching the gallery, shortly after its opening for the evening (half-past seven), I was in time to hear the music, with which the "amusements" commence. The conductor then announced, that a lecture "on the circulation of the blood," was about to be delivered in the lecture-room;

and, by the aid of a little exertion, squeezed myself into the room in time to secure a seat, and there heard a very interesting description of the subject of the lecture, and learned the extraordinary fact that, calculating the heart to contain about two ounces of blood, and force this quantity from it at each contraction, there is not less than 8000 ounces, or nearly a hogshead of the vital fluid, passing through the heart every hour! The lecture continued for half-an-hour, when we were informed that the "Infant Sappho" was about to sing, and, on returning to the gallery, I saw a very pretty little girl—apparently not more than four years old—raised on a table, in front of the orchestra, seeming as full of confidence, as if all the faces looking at her were those of familiar friends. I was astonished at her vocal powers, which were extraordinary for so young a child; though, this precocity may be obtained too dearly, if those who have the care of the little Sappho, do not prevent her exertions becoming too laborious. In addition to the "Infant Sappho," I was much pleased with the performance of a young lady on the harp (Mdlle. Fabroni); she performed two or three brilliant fantasias in the course of the evening. After the music had finished, I walked into one of the upper rooms, which has been transformed into a "Temple of Magic." Here an adept in the "black art" astonished us, by cutting holes in gentlemen's hats, and repairing them at the word of command—turning water into wine, and feats of a similar nature, which he performed with such dexterity, that it was difficult to believe his own confession, that he was deceiving our eyes. After this had finished, the *laughing-gas* was administered in the gallery to such as chose to inhale it. The effects produced were very amusing; but, strange to say, although above half-a-dozen persons breathed the gas, not one of them showed its effects by laughing. They all exhibited a most pugnacious disposition for a few minutes, and, when they recovered from the effects of the gas, laughed heartily at their own behaviour. In the course of the evening, several pieces of music were performed, and the whole concluded with the exhibition of the *Dissolving Views*, representing a variety of pleasing objects, including portraits of the Queen and Prince Albert—the Tower of London, by day, by night, and on fire—the bombardment of the Chinese forts at Chusan, and several other views and portraits. The manner in which the various changes are effected, is very surprising—the views literally *dissolve*; and this exhibition alone is worth the money pald for admission to the gallery. The electrical machine affords great amusement, and is a very fine instrument. The specimens of M. Claudet's Daguerreotype portraits and views, are the most surprising things of the kind to be seen. He can take a perfect likeness in a few seconds. If you will allow me, I will, at another time, notice the various works of art exhibited here,

And remain yours, &c.,

J. H. D.

CONSTRUCTION OF ORGAN-PIPES.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Having observed that the attention of some of your correspondents has lately been directed to the construction and cost of organ-pipes, I have to offer them a suggestion—viz. that such pipes may be manufactured in copper at a small comparative cost, by means of the electrotype process. Some of your readers will, perhaps, think I am joking, but, in sober seriousness, I see not the slightest difficulty in the way, but, on the contrary, many advantages. I would proceed as follows:—Let a cylinder of wood be turned a little smaller than the internal diameter of the tube; let this be coated with wax of a sufficient thickness to make it exactly the internal size; then black-lead it, and place it in the apparatus, which should be on the separate-battery principle. When the deposit is sufficiently thick, make the tube hot enough to melt the wax on the wooden cylinder, when the latter will drop out, leaving the pipe to be dealt with as one of the ordinary material. At any rate, this method is worth a trial. If any of your correspondents should try the experiment, I should be glad to hear the result.

I remain yours, &c.,

W. H.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, May 11, E. O. Hocken, Esq., on the History of Books. Friday, May 13, N. Rogers, Esq., M. D., on the Anatomy of the Eye and the Philosophy of Vision. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, May 12, S. Preston, Esq., on Electricity, Galvanism, and Magnetism. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, May 12, J. S. Buckingham, Esq., on America and the Americans. At eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, May 9, A. C. Lee, Esq., on the Anatomy of the Human Body. At a quarter-past eight o'clock.

QUERIES.

1. Which is the softest and most expeditious method of removing from the fingers the stain caused by sulphate or oxide of zinc? 2. What are the distinguishing principles of the patent disc steam-engine? 3. Have any of your readers a good box camera for sale? W. H.

The simplest and most effectual method of making coloured and black eyes for stuffed birds, with a description of the apparatus used in making them? Also, a good recipe for preserving the skins? NATURALIST.

"An Amateur" will feel obliged if "G. S., Jun.," will ascertain for him the probable expense of the principal and dulciana stops in metal. The pipes will be required for a moderate-sized chamber-organ, about eight feet high. S.

ANSWERS TO QUERIES.

Coloured Glass.—I cannot treat fully on the subject of coloured glass, in consequence of the length of space required, but will speak of two or three of the colours considered the most valuable. In making of colours, care should be taken as to the purity of the materials. A very fine blue may be made, by adding to ten pounds of flint glass, previously melted and cast into water, zaffre, six drachms; half-an-ounce of calcined copper, prepared by putting sheet copper into a crucible, and exposing it to the action of a fire not strong enough to melt the copper, and you will have the copper in scales, which you pound. A very bright purple may be made, by using ten pounds of flint glass as before; zaffre, five drachms; precipitate of calcium, one drachm; which may be purchased at Knight's, Foster Lane, Cheapside. For a gold yellow, twenty-eight pounds of the flint glass, and a quarter of a pound of tartar, which is found in wine, and may be purified by putting it in a crucible in the fire, till it smoke no more; add two ounces of manganese.

"G. Starkey." I never heard of a particular kind of screw, designated the "Elizabethan twist." If "G. S." will peruse my papers on cutting screws in the lathe (see No. 70, 73, 74, and 75), he will obtain every necessary information on the subject. If, however, he allude to a spiral twist, frequently found on old furniture, and which cannot well be called a screw, he will find full particulars respecting the machinery requisite to produce this curve, and which is rather complicated, in Hamelin Bergeron's "Manuel du Tourneur," Paris, 1816, 3 tom., 4to., second edition, tom. ii, pages 67—100, being sections i., ii., and iij., of chap. iv., plate 14. Should "G. S." be unable to procure the work I have referred to, I will endeavour to compress the more material parts, and communicate them through the medium of the PENNY MECHANIC.

A. M.

In reply to "G. W.," I would beg leave to say, I have a fountain complete, and fitted to a handsome glass globe, which I have no use for now, and, therefore, would part with it all for much less than it cost me. I had it made to my order. Address, John Sinkins, Sydenham.

"D. P." A mineral cement is used by dentists, for the purpose of filling decayed teeth, composed of tinfoil, mercury, and iron filings, firmly levigated, formed into a paste, and, when of the consistence of putty, applied to the tooth. The mercury is gradually absorbed into the system, and leaves a metallic plug.

"H. D. Whillock" will find Walker "On Electrotype Manipulation," parts 1 and 2, price 1*s.* each, the best and cheapest work extant on the subject. He will there find, that copper may be plated for the Daguerreotype at a very small cost.

"E. W. Newton." The zinc should be the ordinary sheet zinc—such as that used for pipes, and as thick as possible. It must be amalgamated on both sides, but need not be soldered. Pipeclay is the material usually employed for the porous jars.

"An Amateur Mechanic" will find but two methods of racking the edge of his plate:—first, by means of the ordinary wheel-cutting engine, which will transfer its own inaccuracies to the plate; and, secondly, by first dividing the circumference with a pair of dividers, and then carefully notching it with a file—a sufficiently tedious operation. W. H.

TO CORRESPONDENTS.

J. Arnott.—*We are not acquainted with the precise method adopted in Delbruck's system of soldering. We will endeavour to obtain information on the subject; at the same time, our correspondent might be better satisfied by applying to the agent.*

J. Rolfe.—*We have received his communication, and are obliged to him for it. We have been endeavouring to reply to him satisfactorily on the subject, but, as yet, have been unable to find out a method of fixing the colours in the way he wishes.*

Tyro.—*We do not know that we can give a farther or better description of Beard's patent process for taking likenesses, than he will find in No. 21 of the last volume. The improvement that has taken place since, consists in the portraits being tinted or coloured after being taken. His other suggestions we intend to give our attention to.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

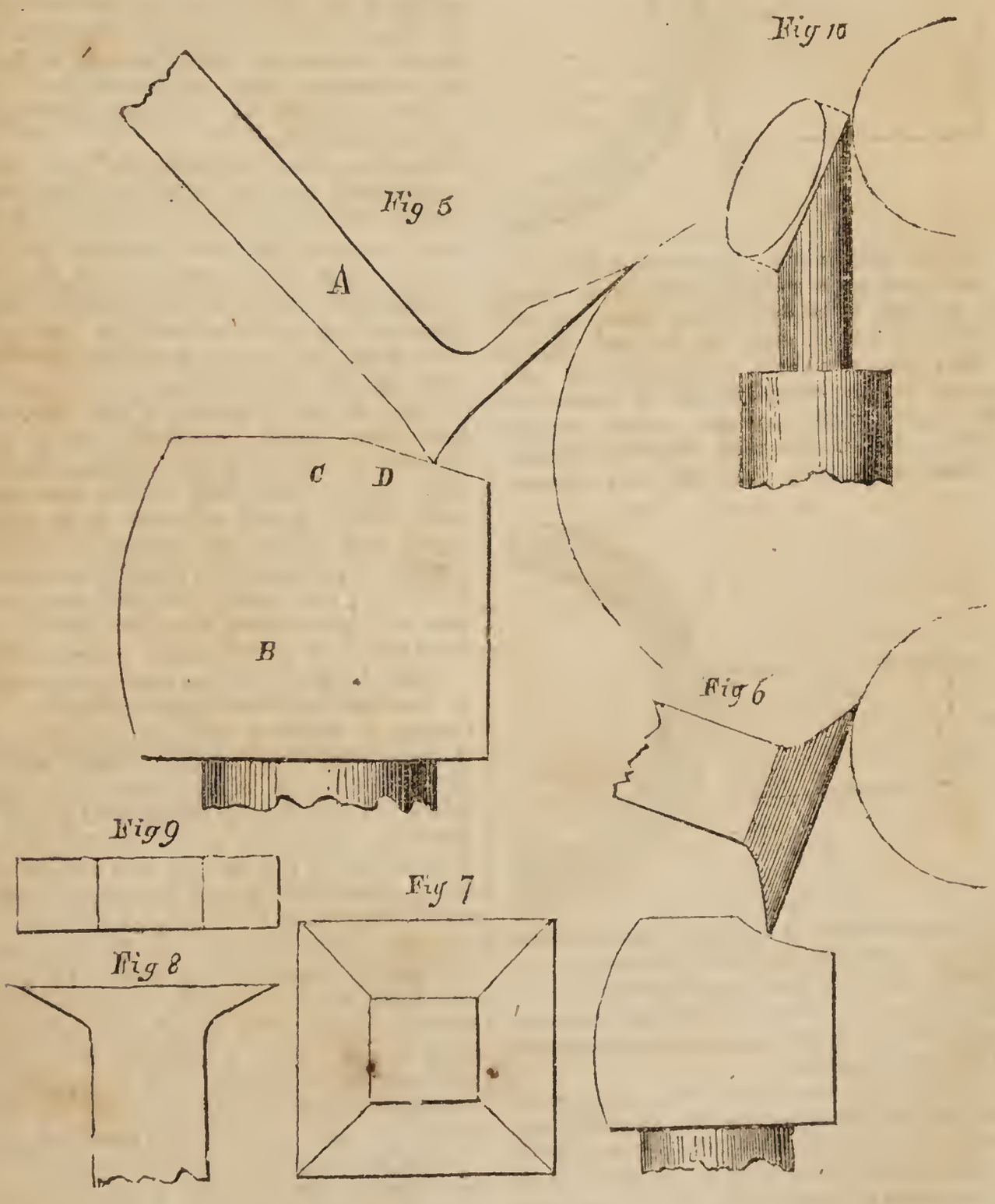
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. **81**, THIRD SERIES. | SATURDAY, MAY 14, 1842. | No. 329, OLD SERIES.

MODE OF PREPARING STEEL FOR TOOLS.



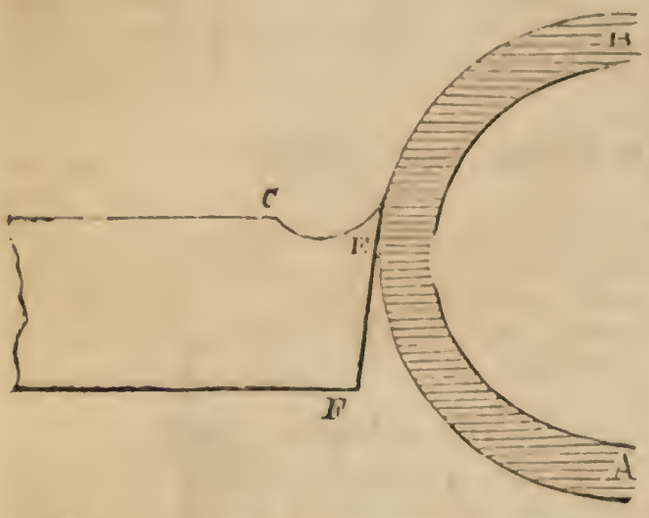
Vol. VIII.—No. 22.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS.

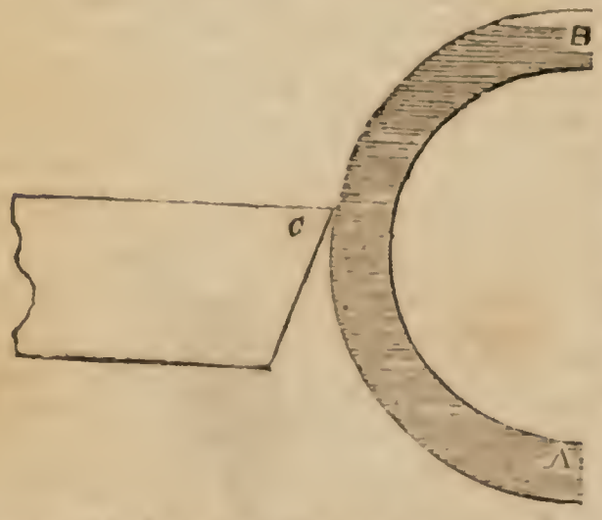
(See Engraving, front page.)

(Continued from page 165.)

In the case of turning, the application of the principle is very clearly exemplified.



The instrument represented above is employed as a turning tool, A B being a portion of a cylindrical body in the lathe; the base, E F, of the tool, should represent, as nearly as possible, a tangent, or, in other words, it should be at right angles to the radius of the curve: but if the tool, shown in the annexed engraving, be similarly placed,



we should find it difficult, nay, impossible, to preserve its point for a single instant; as is evident, from the small cross section at C, the metal being clearly insufficient to resist the strain inseparable from the operation.

It is a singular incident in the history of practical science, that the palpable facts we have adduced, should have escaped the observation even of the best and most experienced workmen; since, reasoning from analogy, and taking the angle given to the cutting edge of turning tools of the most approved make for data, we must conclude, that the perpetual recurrence of accidents and other serious impediments to the correct and accurate performance of a machine otherwise susceptible of the highest degree of excellence, rendered the operator blind to those defects which are, in fact, to be attributed solely to his own want of perception. In no other way can we account for a strange and obstinate adherence to a form of tool, merely because it had the *appearance* of acuteness; but is miserably deficient in those qualities upon which its value entirely depends. This circumstance of itself proves the incalculable importance of a mathematical education to the class of men engaged in our manufactories; inasmuch, as it induces a habit of reasoning from circumstances, and thereby enables us to reach the cause through the effect.

Hitherto, our observations have been confined to turning tools supposed to be firmly secured on the carriage of a slide-rest; we now propose to extend the inquiry to the more general case of tools guided by the hand of the workman, and, therefore, more dependent on his skill. Our object is, not so much to show how little has been achieved in this branch of art, as, by an exposure of the *erroneous hap-hazard* mode prevalent among mechanics, in forming the cutting edge of their tools, to lead them to the *true principle*, which is not only easy in its application and certain in its results, but is capable of performing a greater amount of work more accurately, and with less exertion, in a given time, than can possibly be done by a tool of the usual construction.

That this principle has been disregarded, or but an accidental approximation obtained, is manifest from an inspection of the engraved illustrations of tools, selected as specimens of improved form and make. These figures are faithful copies of drawings expressly made by Mr. Gill* from the tools themselves, and are strongly recommended by that gentleman; they were introduced by a very skilful workman from Manchester, into the engineering establishment of Mr. Jacob Perkins. The tool, fig. 5, is shown edgeways at A, and is represented to have been about one inch broad, with a straight edge, and mounted in a wooden haft or handle of sufficient length to reach beneath the arm of the turner, near to his shoulder, and lodged between his arm and body; it is intended to be held and guided by both hands. The top of the lathe-rest, B, is

* See *Technical Repository*, vol. ix., pages 1.–6, 113—116, 136—139.

inclined or bevelled at C, "in order," as the workman expressed himself, "the better to keep the tool to its work, and prevent it from slipping away." The angle of the heel, at D, is rather acute, that the tool may be more firmly sustained upon the rest, B.

Fig. 6 is an edge view of the *nail-head* turning tool, as employed in use—that is, giving a last finish to cylindrical bodies. This tool is quadrangular, and has four straight cutting edges, as shown in the front view of it, fig. 7. It is formed by *upsetting* the end of a square bar of cast steel, and filing it to shape. After being hardened and tempered to a *straw colour*, either of the two rectangular edges may be ground sharp, leaving the other two ready to be ground to an edge, when the former have become blunt. This tool is frequently made out of a flat bar of steel, and, consequently, with two cutting edges only, as represented in figs. 8 and 9; it is then designated a *spike-head* tool.

Fig. 10 shows a tool invented by that eminent machinist, Sir Isambard Brunel, and employed in his block machinery at Portsmouth, for turning wrought-iron pins truly cylindrical. The tool is simply a portion of a round steel bar, having its end ground off flat at a proper angle. In use, it is placed in a vertical position, and carried along gradually and uniformly in a rectilinear direction; being placed in a suitable carriage, and urged forward by a screw. The elliptic figure, X, is a section of the face of the tool.

DYNAMICAL GEOLOGY.

UNDER this title, I shall endeavour to explain, in a clear and familiar manner, some of those physical changes which are incessantly taking place around us, and which, operating on an extensive scale, and through a long succession of years, are capable of producing effects that materially modify the earth's surface.

On account of the simplicity of the arrangement, I intend to consider that the surface of our planet is subject to change from the operation of three great classes of agents; although, by this, I must overlook, in a great measure, the modification which the forces produce on one another; and these modifications are so complicated, that sometimes the igneous and aqueous forces co-operate to produce a joint effect, to which neither of them, unaided by the other, could give rise. Occasionally, organic causes combine with the inorganic; as when a reef, composed of shells and corals, protects one line of coast from the destroying power of tides and currents, and turns them against some other point; or when drift timber, floated into a lake, fills a hollow to which the stream would not have had sufficient velocity to convey earthy sediment.

The three great classes of agents by which the physical changes and revolutions are effected on the earth's surface, are, the *meteoric*, the *aqueous*, and the *igneous*. Under the first are comprehended the air of the atmosphere, the vicissitudes of heat and cold, moisture and rain, light and electricity, and the wind; under the second, running water of every kind—such as tides, currents, torrents, &c.; the third comprehends volcanoes and earthquakes.

THE METEORIC CLASS.

There is a tendency in even the hardest rock, to absorb oxygen and carbonic acid from the atmosphere, and to be, by that union, disintegrated; and this is a union which is always taking place, though, in some places, with more conspicuous effects than elsewhere.

Heat and cold are, obviously, at all times concerned in exciting dilatations and contractions, and thus keeping up a perpetual but varying motion among the particles upon which they act. Thus, must we partially account for the vast ruin daily witnessed in all mountainous countries. (See my account of M. Agassiz's Glacial Theory.) Mr. Scoresby, in his "Arctic Regions," says, that "the invariably broken state of the rocks appeared to have been the effect of frost." "I frequently observed," says Mr. Darwin, in his "Narrative of the Surveying Voyages of the *Adventure* and *Beagle*," "both in Terra del Fuego and within the Andes, that where the rock was covered the greater part of the year with snow, it was shivered in a very extraordinary manner into small angular fragments." In another place, the last-named author states, that the quantity of crumbling stone on the Cordillera is immense. Occasionally, in the spring, masses of such matter slide down the mountains, and cover the snow-drifts in the valleys, thus forming natural ice-houses. (For more information on this subject, see the section on the "Durability of Granite.")

Every drop of *rain* that falls, as soon as it touches the earth, becomes an instrument for the disintegration and decay of rocks. A traveller, writing on the subject of the Upper Missouri territory in

North America, informs me, that the precipices which hem in the river (Missouri), "have been washed by the rains into every shape. They have the appearance of the ruins of an old cathedral, in some places; in others, of fortifications; while here and there the appearance of old walls would make a person think, that more than Nature had a hand in the formation. There is one large rock called the 'Citadel,' which stands jutting into the river, not less than 300 feet in height, and another at a little distance, which very much resembles Pitt's monument in Edinburgh."

The rains continually washing down and carrying away earth from the mountains and hills of a country, it is necessary that as well the height, as the bulk of them, should answerably decrease; and that they do so, is evident in experience. For example, "the steeple of Craitch, in the Peak of Derbyshire, in the memory of some old men living in 1672, could not have been seen from a certain hill lying between Hopton and Wirksworth; now, not only the steeple, but a great part of the body of the church may thence be seen."

FORMATION OF THE TEETH OF WHEELS.

To the Editor of the Penny Mechanic and Chemist.

SIR,—It should be the aim of every person who contributes to a journal avowedly written for the working classes, so to express himself, that his meaning shall be obvious to the meanest capacity. I, sir, am a poor unlettered man; for, in my younger days, our masters were terribly afraid of education, perhaps because they were themselves ignorant; and the old-fashioned Tories invariably denounced any man who could read and write, as a leveller and a republican! Church and state, passive obedience and non-resistance, were the pass-words of these good Christian gentlemen; but what was meant by these sentences, the poor were forbidden to inquire, on pain of the displeasure of the rich. I, for one, often resolved these things in my mind, and fancied I had discovered their hidden meaning; whereat, like a child, I greatly rejoiced, but only to grieve the more, and to lament my fate more bitterly; for knowledge brought forth sorrow and anguish; the stern conviction that I was a poor man, one doomed "to earn his daily bread by the sweat of his brow," and, therefore, expected to pay the tribute of unconditional obedience to my superiors in rank, and a quota of my earnings, grossly disproportioned to the amount compared with the rent-roll of my employer, or that of Lord Muddlebrain, or Squire Guzzle, for my contribution to the national treasury, was levied on necessaries—the bread I ate, the beer I drank, and the tobacco I smoked; theirs, on luxuries—such as carriages, horses, expensive wines, and costly viands. This, I was told, is one of the wise dispensations of Providence! The author of this sensible saying was a parson, a pluralist, and my lord's chaplain; had I, a poor man, ventured on such speculative ground, I surely should have been called a discontented babbler, possibly a blasphemer; and singularly fortunate should I have been, had I escaped the tender mercies of that arch minister of legal tyranny—a criminal information.

But, Sir, times have changed, and, dating from the passing of the Reform Bill, the people of England have progressed in useful knowledge with a rapidity altogether unparalleled; since it is a fact that cannot be denied, that the vigorous intellect and powers of mind displayed by mechanics, trained and brought into action by institutions founded by the benevolent exertions of a Brougham and a Birkbeck, are, at all events, equal, if not superior, to the mental capacity of those who, during a long series of years, enchained the free minds of a free people, but who, at last, have burst the fetters, and thus proved the truth of that golden apothegm, "Knowledge is power!"

Feeling, as I do, the inestimable value of such information as is suited to the wants of the class to which I belong, and from which I have no desire to emerge, you may well suppose with what pleasure I receive the PENNY MECHANIC, and such like publications; for here our rights, as reasonable beings, are acknowledged, and our wishes courteously considered. I am sure you, as Editor and Director of a Journal, both instructive and amusing, will allow a sincere well-wisher to make a few comments; moreover, being practically engaged in the construction of machinery, I am better enabled to test the accuracy and importance of improvements suggested by your correspondents. Trusting, therefore, you will not consider me presumptuous, I would direct your attention to a paper "On the Formation of the Teeth of Wheels," in No. 71, and signed "T. R. Bilbrough." I am not certain that I understand the author's descrip-

tion; for instance, he tells us that "a wheel and pinion will have the same force moving each other, when the axes of both are parallel; or, in other words, when a line is drawn from the point of contact of the teeth, perpendicular to their respective curves, so as to pass through the point where the primitive circumferences meet." Now, Sir, this is quite unintelligible to a practical man, like myself. I suppose the gentleman is very learned—he certainly is too much so for me—inasmuch, that the condition of parallelism of the respective axes of the wheel and pinion, does not necessarily include the explanation which immediately follows. Perhaps "T. R. Bilbrough" will be so good as to explain what he means by the proposition with which he starts—viz. that "a wheel and pinion will have the *same force moving* each other," &c. We are in the habit of estimating the motive *power* of toothed wheels in a different way, in this part of the country; but, as I have observed already, we are very illiterate.

My young master, to whom I showed the paper in question, tells me, that teeth of a somewhat similar configuration, and called saw-teeth, were introduced some years ago, if I am not mistaken. He also read to me some passages from a treatise on the teeth of wheels, by a very learned man, named Camus, which I should like to copy for insertion in the PENNY MECHANIC, if you will grant me this indulgence. For the present I conclude,

Your obedient servant,
A JOURNEYMAN MILLWRIGHT.
Manchester.

ON GLASS-BLOWING.

(Continued from page 159.)

Blowing.

THIS will try the skill and patience of the operator; and, indeed, the beginner must not expect to succeed well in any of the before-mentioned operations, without practice; but this one requires great care. You commence by sealing the tube, as described in the last paragraph, page 159; after which collect, at the sealed end, more or less glass, according to the size and thickness of the bulb you wish to form. When you have succeeded in making this extremity of a good form and well rounded, bring it to a reddish-white heat, turning the tube the while rapidly between the fingers; when completely soft, remove it from the flame, and project the air from the mouth gently, but quickly, into it, not discontinuing for a moment the movement of rotation, until the bulb is either of the proper size, or the end of the tube has become too cold and hard to be affected by the air forced into it: if the latter be the case, heat it again, and proceed as before; but be careful to turn it rapidly while in the flame, for fear that the sides of the bulb, being thin, should sink together, and become deformed. If the tube be of large diameter, it will be necessary to contract the end through which you blow, in order that it may be turned round with facility while in the mouth. Instead of collecting the glass at the sealed end, as before directed, it is sometimes more convenient to blow a series of small bulbs on the tube close to one another, and then, by heating the intervals and blowing, to unite the small ones into a bulb of the requisite size. It is also absolutely necessary that the glass should be held out of the flame during the act of blowing, or it is impossible to make bulbs, the sides of which shall be of the same thickness. When you are operating with capillary tubes, the air must not be forced into them by the mouth, but by means of a bladder or India-rubber bottle; for the moisture from the mouth would soon fill up the opening, and all attempts to form a bulb would be useless.

To blow a bulb in the middle of a tube, one end must be stopped up, the glass softened and accumulated in the middle, and the mouth applied to the other extremity, which, if the tube be large, has been previously contracted. To obtain a round bulb, hold the tube horizontally while blowing into it; for a flattened one, hold it perpendicularly, with the hot end above; and an oval or pear-shaped one may be obtained, by keeping the fused end downwards. The eye must be kept continually on the bulb, while forcing the air in, otherwise, by too much being suddenly thrown in, it may burst.

Piercing.

This operation consists in forming a small hole at the side of a tube, for the purpose of soldering another tube into it, &c. If the tube be open at both ends, stop one up with a bit of wax or a CORK, then at the place you desire to pierce, direct the flame, until it has acquired a reddish-white heat, and blow suddenly and forcibly into the other end; the softened part will be burst, and a hole formed, with the lips extending outwards. Should it be necessary that the edges of the hole should extend inwards, instead of blowing, suck the air out until the hole is formed. The

edges may be rounded, by directing the flame on them for a few seconds. A hole may also be made, by closing both extremities of the tube, then heating it as before; the air expanding inside, will force its way out through the melted part.

Bending.

A reddish-brown heat is the best for bending, which operation presents no difficulty, if the tube be of small diameter, and the sides thick. You heat a zone, of one or two inches in extent, at once, by moving the tube backwards and forwards in the flame, and take care to bend it gradually. When the tube is large and thin, more caution is necessary, or it will be bent too suddenly, and will be deformed. To avoid this, it is necessary first to seal the tube at one end, and then, while giving it a certain curvature, to blow cautiously by the other end. This leads us to the consideration of the last article,

Soldering.

If the two tubes you purpose soldering together, be of the same size and thickness, this is easily performed, by merely heating the ends until melted, then presenting them to each other, and carefully working them together. In order to amalgamate the glass of the one with the other, let them cool gradually, and endeavour not to make the glass at the "join" thicker than at any other part of the tube. If, however, they be of different sizes, the small one must have the mouth that is to be joined to the other, widened, as has already been shown. When a tube is to be soldered to the side of another, the one must be pierced, and the edges extended. In all cases, the extremities to be joined must be of the same diameter, and the thickness preserved throughout as uniformly as possible. You should avoid joining together tubes made of different sorts of glass—as hard and flint glass, for instance—because these two species of glass experience a different degree of contraction on cooling, and, consequently, will separate from each other when cold.

If the student could have the opportunity of witnessing the operations of a person skilled in this art, with these instructions, and a little practice, he would soon become an expert glass-blower.

W. H. W.

CALOTYPE DRAWING.

To the Editor of the Penny Mechanic and Chemist.

Sir,—The following is an answer to a query of "G. S. Jun.," in one of your last Numbers, the insertion of which will oblige

Your obedient servant,

W. H.

Mr. Talbot has discovered a method of producing images on paper in a few seconds of time; but the effect is very different to that known by the name of the Daguerreotype; inasmuch as it has the appearance of a sepia drawing, but without the microscopic finish, which constitutes the most pleasing feature of Daguerre's process. The paper is prepared as follows:—Take the best writing-paper, and cut off the water-mark, if there be any; dissolve 100 grains of crystallized nitrate of silver in six ounces of distilled water; wash the paper with this solution with a soft brush, on one side, and mark that side; dry the paper cautiously before a distant fire, or else let it dry spontaneously in a dark room; when dry, or nearly so, dip it into a solution of iodide of potassium, containing 500 grains to a pint; let it stay in two or three minutes, then dip it in water; dry it lightly with blotting-paper, and finish drying it at a fire which will not injure it, even if held pretty near; or it may be left to dry spontaneously. All this is best done in the evening by candle-light. This prepared paper is called iodized paper. It is scarcely sensitive to light, but still ought to be kept in a portfolio or drawer, until wanted for use. It may be thus preserved any length of time, without spoiling or undergoing any change. The remaining part of the operation is best deferred till shortly before the paper is required. The paper must then be washed in a liquid prepared in the following manner:—Dissolve 100 grains of nitrate of silver in two ounces of distilled water; add to it one-sixth of its volume of strong acetic acid: call this mixture A. Make a saturated solution of a crystallized gallic acid in cold distilled water: call this B. Mix the two liquids in equal volumes, but only in a small quantity at a time, as the mixture will not keep without spoiling. This is called the gallo-nitrate of silver. Wash the paper with this solution with a soft brush, upon the side previously marked: this should also be done by candle-light. Let the paper rest half-a-minute, and then dip it into water. Dry it lightly with blotting-paper, and then finally before a fire, hold-

ing it at a considerable distance therefrom. When dry, it is fit for use. Mr. Talbot states, that the tincture of galls, diluted with water, may be used instead of gallic acid, but he does not think the results so satisfactory. With an ordinary camera, Mr. Talbot states, that one minute will be sufficient to produce the image; but with one, the aperture of which is one-third the focal length, and the object very white, one second is sufficient. The image requires to be rendered visible, by washing the paper again with the gallo-nitrate, and warming it; repeating this till it is sufficiently strong and clear.

To fix the picture, it must be first washed with water, then lightly dried with blotting-paper, and then washed with a solution of bromide of potassium, containing 100 grains to eight or ten ounces of water. After a minute or two, it should be again dipped in water, and then finally dried. The picture is thus strongly fixed, but is still transparent. Being a *negative* representation, in which the lights are represented by shades, copies may be obtained, also, on calotype paper, which will present the true appearance, as it is in nature. Mr. Talbot, however, prefers using the ordinary photographic paper for the copies; as he thinks the tints are more pleasing. It, however, takes a longer time—from three to thirty minutes of sunshine, according to the subject. The copies are made by placing the calotype picture on a sheet of photographic paper, with a board beneath, and a plate of glass above, and pressing them into close contact. After a calotype has furnished several copies, it sometimes grows faint, and no more good copies can be obtained from it: but these pictures possess the remarkable property of being susceptible of revival. This is effected by washing them again with the gallo-nitrate, and warming them. This causes the shades to darken, while the lights remain unaffected. In renewing the picture it frequently happens, that details make their appearance, which were not seen before, having been latent all the time, yet not destroyed by the exposure to sunshine.

W. H.

CAUSE OF BLUE ON STEEL.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I beg leave to apologise for again addressing you on the cause of blue on steel; but I beg to inform "Mr. Reeves," that I still adhere to my assertion of the oxygen not being attracted from the atmosphere; but you are aware, Sir, that I cannot be answerable for "Mr. Reeves'" misapplication of the meaning of my words. If "Mr. Reeves" will be kind enough to refer to the articles I have previously written on this subject, he will perceive that the valves are not raised by the pump; also, that I have not stated that a perfect vacuum could be obtained, but a nearer approach to a vacuum, than with any other air-pump, on account of the air being rarified. I do not intend to say "Mr. Reeves" is a novice in the use of the air-pump; but really, Sir, it appears to me, that he wishes to make others condemn him as one, by his simple queries as to the method I adopted to "introduce the steel, without admitting air." Such a simple query needs not an answer. I have equal authority to inquire of him, if he would introduce the mercurial guage (to ascertain the pressure of the air) within the receiver after the air was exhausted from it, or place it in the receiver previously to working the syringe.

1st. "Mr. Reeves" states, that he is perfectly satisfied with the result of his experiment; but I beg to inform him that I am not, and will endeavour to convince him of the fallacy of it. 2ndly. "Mr. Reeves" states, that "any liquid may be used that does not act on steel." True; I agree with him there; but allow me to inform him that, in testing the experiment, he should use a liquid or fusible metal that has not any affinity for oxygen, and, I presume, that the result would be very different; for instance, we might use some of the acids, and heat them to the required temperature, that have not any effect upon steel; but they would very quickly attract the blue (oxygen) from the steel, as fast as it was produced. The experiment is the same with the fusible metals, on account of their affinity for oxygen.

I remain yours, &c.,

T. R. Bilbrough.

[We insert Mr. Bilbrough's letter, but must decline any more on the subject. As both parties appear quite to misunderstand each other in words more than in idea, the controversy would be an unprofitable one.—Ed.]

MECHANISM OF ORGANS.

To the Editor of the Penny Mechanic and Chemist.

Sir,—If at some convenient season you will be so kind as to insert the following

in your useful Magazine, you will very much oblige

Your much amused reader,

W. R. N.

I offer "G. S., Jun.," my sincere thanks for the masterly delineation of the mechanism, scales, &c., of the king of instruments—the organ, in his kind answer to "L. V." I find that nicking pipes is a matter of consequence. Does the nicking of pipes alter their tone, or what are the intention, use, and order, of nicking; and have the large pipes the same number of nicks as the small pipes belonging to the same stop? If you will reply to this at some leisure moment, you will much oblige

Yours very respectfully,

W. R. N.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, May 18, E. O. Hocken, Esq., on the History of Books. Friday, May 20, William Pease, Esq., on Geometry, Arithmetic, Trigonometry, &c. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, May 19, J. S. Buckingham, Esq., on the United States of America. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, May 19, Dr. Mitchell, on the Rise and Downfal of the Empire of the Turks. At eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, May 16, W. M. Chatterley, Esq., on the Application of Chemistry to Agriculture. At a quarter-past eight o'clock.

QUERIES.

The best and simplest way to analyze different soils, and what apparatus will be required for the same? Also, a test for the different component parts they contain? JAMES SCOTSON.

Where can I procure the most recent work on the manufacture of British and foreign lace?

GULIELMUS.

1. A few practical hints on the use of the alcoholic still, and the way to manufacture one, cheap and simple? 2. How to separate alcohol from wines, beer, &c., without any distillation, or raising the temperature of the vinous liquor? I presume it is done by chemical agency, but am unacquainted with the process and the chemicals.

T.

The simplest method of refacing common tanned leather—such as bullocks' hides? My object is to glue strips of the same upon flat surfaces of wood, and, when required, to reface it very smooth, so as not to be removed by friction.

A. S. B.

1. How to solder leaden pipes? 2. How to make brass solder, which is commonly used for brazing copper work? 3. How is the composition made, called solder, which the smiths use to harden iron, by rubbing it on the iron while it is hot, and then immersing it in cold water?

JAMES SHEPPARD.

ANSWERS TO QUERIES.

"Utile." The various details connected with engraving on steel plates, are too important, and would occupy too much space, to be made intelligible within the limits of a few lines. I shall, probably, treat the subject of decarbonized steel in a series of papers, which will form a sequel to my communications on steel, already inserted in the PENNY MECHANIC. In the meantime, "Utile" may consult with advantage Dr. Ure's "Dictionary of the Arts and Manufactures," the "Transactions of the Society of Arts," and Gill's "Technical Repository;" in both of which he will find a fund of useful practical information, by Jacob Perkins, Warren, and Edmund Turrell.

"M. Lane." I think he would find all the elementary information he needs, in Grier's "Engineer's and Mechanic's Calculator;" but if he wish to become thoroughly acquainted with this difficult subject, he had better get Buchanan on "Mill-work and Teeth of Wheels," by Rennie; the last edition, just published, which contains the very ingenious and interesting papers of Professor Willis, on the teeth of wheels.

AMATEUR MECHANIC.

"G. Starkey" can make a tough electrotype composition, by melting white wax and adding a little white resin; pour on to the plaster cast, and, when cool enough, blacklead it, which will, in some measure, prevent the mould from cracking.

WATKINS.

"F. T. L." The spectacles must be first polished, and then subjected to heat, till of the desired hue. Cyanide of gold (solution) may be obtained at Newberry's, 60, Fetter Lane, at 2*s.* per oz.

TO CORRESPONDENTS.

T. E.—*We believe he can purchase the article at Maw's, 11, Aldersgate Street; they can, at least, inform him where it is to be procured.*

C. G. Sidey.—*Mill-boards can be procured at any wholesale stationer's, but not cut to any particular size for book covers.*

W. C., Jun., *can purchase any kind of blowpipe at Palmer's, 103, Newgate Street, where he can also be informed as to the size required. We beg to inform him, that no remittance is necessary in order to insure the insertion of queries in the* PENNY MECHANIC.

A Constant Subscriber.—*Our reply to "W. C., Jun.," will give him the required information.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 82, THIRD SERIES. | SATURDAY, MAY 21, 1842. | No. 330, OLD SERIES.

MODE OF PREPARING STEEL FOR TOOLS.

FIG. 11.

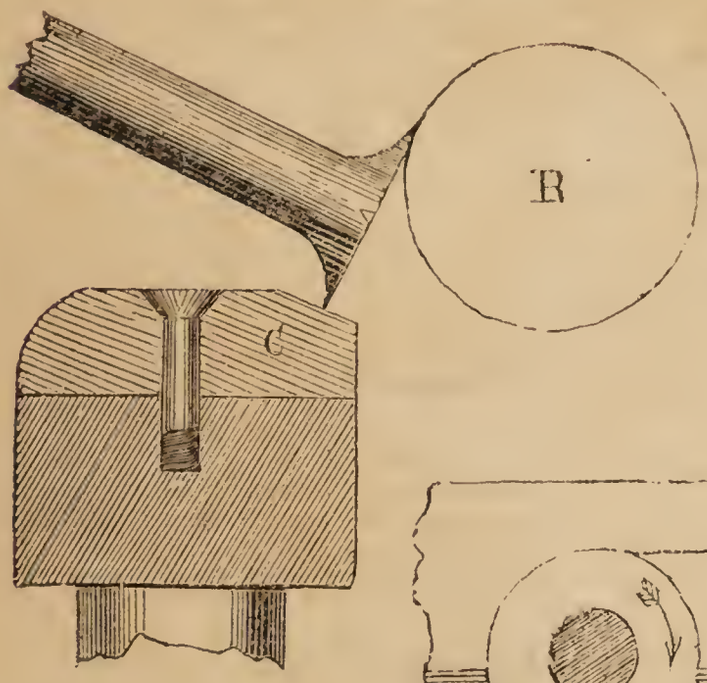


FIG. 12.

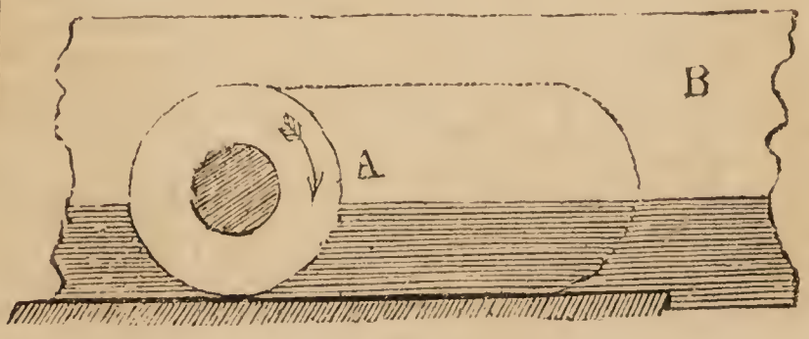


FIG. 14

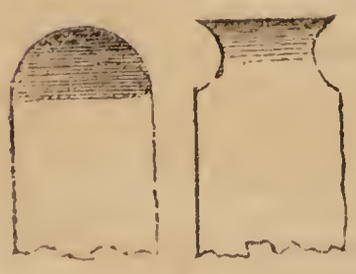
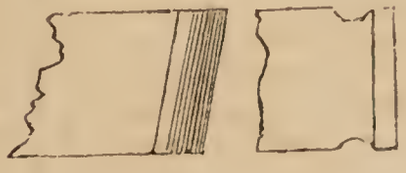


FIG. 13.



Vol. VIII.—No. 23.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney

ON STEEL AND THE MODE OF PREPARING IT FOR TOOLS, &c.

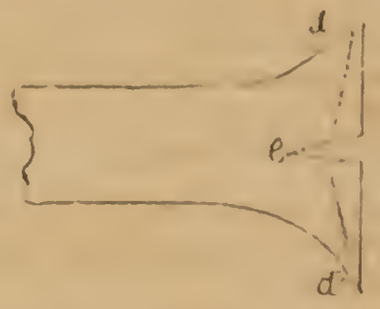
(See Engraving, front page.)

(Continued from page 171.)

Fig. 11 represents the *circular nail-head* tool, formed by *upsetting* one end of a round bar of cast steel. In using it, the top of the rest should be faced with brass, to prevent injury to the edge of the tool, which is slowly revolved upon the rest, and thus continually presents a new edge to the work. A, fig. 11, shows the tool as actually applied; B, a cylindrical body, to be turned down; C, the top of the lathe-rest, with a plate of brass affixed to it by screws, one of which is visible. Fig. 12 shows a side view of a portion of the cylindrical body, B, and of the rest, C; likewise a back view of the turning tool, A, taken at right angles to its flat face. The arrow and the dotted lines mark the circular and rectilinear motion, combined, of A, on the surface, C.

The engravings are, we apprehend, sufficiently clear and explicit to enable any one to see at a glance the characteristic peculiarities of this tool, which, slightly modified, is likely to prove of great utility to the metal-turner. We shall, therefore, subjoin a few suggestions as to the mode of construction.

It is evident, that the circular form of this tool admits of it being turned in the lathe into shape—advantages possessed but by few turning tools. It is easily forged from a round bar of cast steel, by means of a proper mould, known among nail-makers by the name of a *bore*. We commence by heating one end of the bar to a dull-red heat; we then *upset* or thicken that part, by hammering it until a sufficient portion of the steel projects above the top of the bore, when fitted into it, to form the head of the tool; we then, with the hammer, spread it uniformly all round upon the face of the bore, till it approaches the requisite thickness; allowing, of course, for reduction by turning down. The tool must then be annealed in the manner we have already recommended—namely, by the application of heat just below that necessary for hardening—and plunged into cold water; we then again place it in the bore, and conclude the forging by hammer-hardening it cold, in order to condense the pores and render the tool tougher. Lastly, we subject it to a similar process of annealing, and finish by turning it in the lathe to its exact shape, as shown in the annexed figure. Previously, however, to this operation, we must drill a conical hole in the centre, otherwise it could not be kept steady in the lathe. Instead of turning the face plane—that is, at right angles to an imaginary line drawn through its axis—we prefer the base slightly concave, as shown by the dotted lines *d e d'*;



the strength of the metal will be very little affected, but the capabilities of the tool, as a cutting instrument, considerably increased; the back should also partake of a concave form. It may now be hardened and tempered; after which, it is to be replaced in the lathe, and a rotary motion being communicated, the circular edge may be brought to a high degree of acuteness, by the application of a piece of Turkey stone, with plenty of oil. A turning tool, thus constructed, will be found to fulfil all the conditions required by the principle we have explained and exemplified in No. 3; added to which, it is very durable, on account of the cutting edge in contact with the material continually changing its position: moreover, it performs its work with a delicacy and precision of cut, which distinguish the automaton power of a slide-rest, but are rarely attained by manual dexterity; in fine, it is more under the control of the hand, than any tool with which we are acquainted.

Fig. 13 exhibits a *nail-head* tool, which differs from that described in page 171, figs. 5 and 6; its end being made *oblique* and not square, as there represented. We have given a top and a side view of this tool, which, from the shape of its cutting edge, is, doubtless, useful in many cases.

Fig. 14 presents two views of the *semi-circular nail-head* tool; its end is formed into a half-cylinder, and either side is made concave, consequently it has two cutting edges; it is somewhat similar to the tools described in the last paper, but is destitute of the sustaining back point or heel. This is stated to be a very serviceable, and readily-formed tool, when applied to rough cut-work, or to turn hollows and shoulders.

In the *Journal des Ateliers*,* we find a

* An excellent periodical journal, edited by Paulin Desormeaux, and devoted entirely to

description of an ingenious mode of converting a square bar of steel into a turning tool, without having recourse to the forge. This, considering the danger to be apprehended from over-heating, and, therefore, deteriorating the quality of the steel, we deem of the last importance to mechanics; especially as the details are so plain and unpretending, that any person, however inexperienced, cannot fail of success. A. M.

HISTORY AND PROGRESS OF THEORETICAL AND PRACTICAL MECHANICS.

No. IV.

About the beginning of the eighteenth century, the celebrated dispute about the measure of active forces was keenly agitated among philosophers. The first spark of this war, which for forty years England maintained, single-handed, against all the genius of the Continent, was excited by Leibnitz. In the Leipsic Acts for 1686, he asserted that Descartes was mistaken in making the force of bodies proportional to their simple velocity. He showed that a body, with a velocity of two feet, acquires the power of raising itself to a height four times as great as that to which a body could rise with a velocity of only one foot; and hence he concludes, that the force of that body is as the square of its velocity. The Abbé de Cotilon, a zealous Cartesian, allowed the premises of Leibnitz, but denied his conclusion. The body, said he, which moves with a velocity of two feet, will certainly rise to quadruple the height of another body that has only the velocity of one foot; but it will take twice the time to rise to that height, and a quadruple effect, in a double time, is not a quadruple force, but only a double one. The theory of Leibnitz was supported by John Bernouilli, Herman, Gravesende, Musghenbroeck, Poleni, Wolff, and Bulfinger; and the opinion of Descartes by Maclaurin, Stirling, Clarke, Desaguliers, and other English philosophers. The question was at last involved in metaphysical reasoning; and if the dispute did terminate in favour of either party, the English philosophers were certainly victorious. It appears, in the clearest manner, that the force of a moving body, indicated by the space which it describes, is as the simple velocity, if we consider the space as described in a determinate time; but it is as the square of the velocity, if we do not consider the time in which the space is described. The question, therefore, comes to be this:—In estimating the forces of bodies in motion, ought we to take time into consideration? If, with the followers of Leibnitz, we reject this element, then we may maintain that the force of a child is equal to that of a man carrying a load; because the child is also capable of carrying the same load, though in small parts, and in a greater length of time.

In 1743, D'Alembert published his "Traite de Dynamique," founded upon a new principle in mechanics. This principle was first employed by James Pernouilli, in his solution of the problem of the centre of oscillation; but D'Alembert had the honour of generalising it, and giving it all that simplicity and fertility of which it was susceptible. He showed, that, in whatever manner the bodies of one system act upon another, their motions may always be decomposed into two others at every instant, those of the one being destroyed at the instant following, and those of the other retained; and that the motions retained are necessarily known from the conditions of equilibrium between those which are destroyed. This principle is evidently a consequence of the laws of motion and equilibrium, and has the advantage of reducing all the problems of dynamics to pure geometry and the principles of statics. By means of it, D'Alembert has resolved a number of beautiful problems which had escaped his predecessors, and particularly that of the precession of the equinoxes, which had occupied the attention of Newton. In his "Traite de Dynamique," D'Alembert has likewise reduced the whole of mechanics to three principles—the force of inertia, compound motion, and equilibrium; and has illustrated his views on this subject, by that profound and luminous reasoning which characterises all his writings.

Another general principle in dynamics was, about this time, discovered separately by Euler, Daniel Bernouilli, and the Chevalier D'Arcy, and received the name of "conservation of the momentum of rotary motion." According to the first two philosophers, the principle may be thus defined:—In the motion of several bodies round a fixed centre, the sum of the products of the mass of each body, multiplied by the velocity of its motion round the centre, and by its distance round that centre, is always independent of the mutual action which the bodies may exert upon each other, and always preserves itself the same, provided the bodies be not influenced by any external cause. This prin-

practical mechanics. Paris, tom. i., 8vo., 1830, pages 57—9, 81—3.

ciple was given by Daniel Bernouilli, in the "Memoirs of the Academy of Berlin for 1746;" and the same year by Euler in the first volume of his works. They were both led to the discovery, while investigating the motion of several bodies in a tube of a given form, and which can only turn round a fixed point. The principle discovered by the Chevalier D'Arcy, was given in a memoir dated 1746, and published in the "Memoirs of the Academy for 1747." He showed, that the sum of the products of the mass of each body by the area which its radius vector describes round a fixed point, is always proportional to the times. The identity of this principle, which is a generalization of Newton's theorem about the areas described by the planetary bodies, with that of Euler and Bernouilli, will be easily perceived, if we consider that the element of the circular arc, divided by the element of the time, expresses the velocity of circulation; and that the element of the circular arc, multiplied by the distance from the centre, gives the element of the area described round that centre: so that the principle of Euler is only a differential expression of the principle of D'Arcy, which he afterwards expressed in this form:—That the sum of the products of the masses of each body by their velocities, and by the perpendiculars drawn from the centre to their lines of direction, is a constant quantity.

The principle of least action, which was first proposed by Maupertuis in 1742, consists in this—that when several bodies, acting upon one another, experience any change in their motion, this change is always such, that the quantity of action (or the product of the mass by the space and the velocity) employed by nature to produce it, is the least possible. From this principle, Maupertuis deduced the laws of the reflection and refraction of light, and those of the collision of bodies. He afterwards extended its application to the laws of motion, and made the principle so general, as to comprehend the laws of equilibrium, the uniform motion of the centre of gravity in the percussion of bodies, and the conservation of active forces. This celebrated principle was attacked by Koenig, professor of mathematics at the Hague, in the Leipsic Acts for 1751, who not only attempted to show its falsity, but asserted that Leibnitz had first described it in 1707, in a letter to Herman. The paper of Koenig gave rise to a long and violent dispute about the accuracy of the principle, and the authenticity of the letter of Leibnitz. The Academy of Berlin interfered in behalf of their president, and gave importance to a controversy which was too personal to merit the attention which it received.

(To be continued.)

DYNAMICAL GEOLOGY.

(Continued from page 172.)

Electricity sometimes lends itself as a powerful destructive agent. For instance, at Funzie, in Fetlar, about the middle of last century, a rock of mica schist, 105 feet long, ten feet broad, and, in some places, four feet thick, was in an instant torn by a flash of lightning from its bed.

Hurricanes—i. e. furious winds attended by deluges of rain—produce very considerable changes, in a short time, on the surface of the land. It has been computed that the wind, at such times, travels at the rate of from eighty to 100 miles per hour; levelling forests, throwing down buildings, and destroying, to a great amount, animal life. Furious torrents are suddenly formed, which sweep away a large proportion of the uprooted trees, and the bodies of numerous terrestrial animals destroyed by the effects of the wind. Hurricanes have great effect upon the sea, raising the waves to an enormous height. In Jamaica, in 1780, during a hurricane, a great wave burst upon Savanna la Mar, and swept away the whole town in a moment. In May, 1782, a most furious whirlwind, accompanied by heavy rains, almost destroyed Formosa, an island near the coast of China. In May, 1787, a dreadful inundation of the sea was caused at Cormiga, Ingeram, and other places on the coast of Coromandel, in the East Indies, by a hurricane blowing from the north-east, which raised the waters so, that they rolled inland to the distance of twenty miles from the shore, swept away many villages, drowned more than 10,000 people, and left the country covered with marine mud, on which the carcasses of about 100,000 head of cattle were strewed. The same coast of Coromandel was, in May, 1832, the scene of another catastrophe of the same kind. Barbadoes, the most eastern of the Caribbee Islands, is subject to hurricanes of a dreadful and devastating nature.

THE AQUEOUS CLASS.

Springs.—Collected in the atmosphere, the rain is filtered through the sandy rocks, passes rapidly by the joints of the calcareous strata, and is stopped by the clays, and by dykes and faults; it then issues in springs, but it is no longer the

same water. Rain water is, indeed, far from being in a state of purity; it contains always carbonic acid, frequently some muriatic acid or chloride of sodium, besides other irregular mixtures. In passing through the rocks, it absorbs lime, oxide of iron, &c., and, on issuing in the form of springs, loses its excess of carbonic acid, and again deposits carbonate of lime, carbonate of iron, &c. From some springs, the quantity of carbonate of lime deposited is enormous; with the water of others, sand, gravel, fossil shells, and zoophytic fragments issue.

Springs which have an impeded issue to the surface, are the most general cause of landslips: we may consider the great fall of the Rossberg as a case of this kind. The effects of this terrible convulsion, were the entire destruction of the villages Goldau, Bussingen, and Rothen, and a part of Lowertz. Such a mass of earth and stones rushed at once into the Lake of Lowertz, although five miles distant, that one end of it was filled up, and a prodigious wave passing completely over the Island of Schwanau, seventy feet above the usual level of the water, overwhelmed the opposite shore, and, as it returned, swept away into the lake many houses with their inhabitants; the village of Seewen, situated at the farther end, was inundated, and some houses washed away; and the flood carried live fish into the village of Steinen. The chapel of Olten, built of wood, was found half-a-league from the place it had previously occupied, and many large blocks of stone completely changed their position. ("Hand-book for Switzerland, Savoy, and Piedmont," published by Murray. Also "Simond's Switzerland.")

\- - - - Mountains have fallen,
Leaving a gap in the clouds, and, with the shock,
Rocking their Alpine brethren; filling up
The ripe green valleys with destruction's splinters,
Damming the rivers with a sudden dash,
Which crush'd the waters into mist, and made
Their fountains find another channel---thus,
Thus, in its old age, did Mount Rosenberg.

BYRON.

An extensive landslip occurred in December, 1839, near Axmouth, Devon. Those who desire an account of this phenomenon, may peruse it in No. 505, "Penny Magazine."

It has been found, that when economy of wheaten flour is desirable, that 1 lb. of rice goes as far as 8 lbs. of flour; and that 2 lbs. of potatoes are equal to 1 lb. of flour. Five pounds of boiled potatoes, mixed with 20 lbs. of flour, make as good bread as can be eaten. Bran boiled in the water used for kneading dough, increases the weight.

CAUSE OF LOBSTERS AND CRABS CHANGING COLOUR.

To the Editor of the Penny Mechanic and Chemist.

SIR,—It is well known that the shells of certain molluscous animals—such as lobsters and crabs—undergo a remarkable change of colour when boiled with the creatures they contain, in salt and water, turning from deep black to a bright red. Now I have never met with any explanation of this curious fact, and I am, therefore, induced to offer to your notice the following hypothesis on the subject:—I conceive that the change of colour above alluded to, is attributable to the shells of these mollusca containing iron in some peculiar form, probably in the state of protoxide; and that this iron, in consequence of the boiling, becomes released or disassociated from the animal matter, as well as the carbonate of lime (the basis of all such shells) with which it was previously combined; thus enabling it, by being acted upon by the muriate of soda, to pass into a higher stage of oxidation, or into that of the peroxide, which, being red, readily accounts, according to this supposition, for the colorific change which we have just been considering.

Trusting that the above communication will not be altogether unacceptable to your readers, I have the honour to remain

Your obedient servant,
W. H. O.

BEARD'S PHOTOGRAPHIC PORTRAITS.

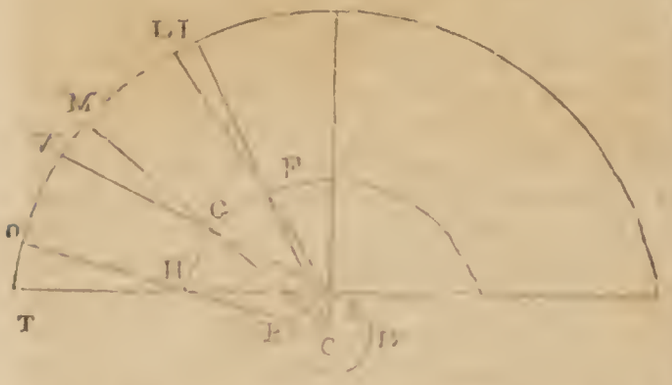
WE have been this week highly pleased and gratified with a visit to one of Mr. Beard's establishments for taking portraits by photography. We gave a description of this very interesting and important invention in No. 21 of the last volume of the PENNY MECHANIC; since which time, Mr. Beard has greatly improved on the art, by tinting or colouring the portraits to the taste of the party. Several thousands of persons have already availed themselves of the opportunity of having their likenesses taken; and we believe, that in scarcely one instance have they failed in giving the most perfect satisfaction: it cannot, indeed, be otherwise, since the portrait must be a precise facsimile of the countenance of the person while sitting.

Another peculiar advantage of this process, is the short time required for a sitting—only twenty seconds. This has

been a great inducement for many who have had objections to sitting two or three hours in one posture; not thinking the obtaining of a portrait worth the trouble of subjecting themselves to so fatiguing a process.

We doubt not, that Mr. Beard will amply reap the reward of his talent and perseverance, in bringing this most interesting art to so great perfection; and we trust, that it will be a stimulus to still farther research for the continued development of fresh ideas, towards the attainment of the greatest possible perfection in the science of photography.

TO FIND THE PARALLAXES AND DISTANCES OF THE HEAVENLY BODIES.



LET D A P represent the earth; C, its centre; A, the station of a spectator on its surface; and F G H, different places of the moon, or any other heavenly body; T O, N M, L I, are its different parallaxes, and T H O or A H C, M G N or A G C, &c., angles of parallax.

To Measure the Moon's distance from the Earth.

The moon's horizontal parallax is the angle which a semi-diameter of the earth would subtend, viewed directly from the moon.

Let H be the moon in the horizon, observed from A, and C the centre of the earth. In the triangle, A H C, let the angle, A H C, the moon's horizontal parallax, be found. The angle, H A C, is a right angle, and A C, the earth's semidiameter, is known to be 3985 miles. Hence A C, the sine of A H C, 57′ 11″, is to 3985, as A H, as a radius, to the number of miles in H C, the moon's distance from the earth. The moon's mean distance is thus found to be 240,000 English miles.

To Measure a Planet's distance from the Sun.

Because the real distances of the planets from the sun, are as their proportional distances, therefore, as the earth's proportional distance is to that of any other planet from the sun, so is the earth's real distance to that of any other planet from the sun in miles. Hence are found the distances of the planets from the sun in miles:—

Mercury	36,841,168
Venus	68,891,186
Mars	144,760,806
Jupiter	494,265,155
Saturn	906,183,000
Herschel	1,822,413,975

WRITING SEVERAL COPIES AT ONCE.

To the Editor of the Penny Mechanic and Chemist.

SIR,—A suggestion which, I think, might be serviceable, is a method of writing several copies of any article at the same time. It consists merely in having a sort of compasses, with as many legs as there are copies to write; the legs being spread out, so that each leg has the range of one page. On each of the legs there is to be affixed a pen, and the whole is to be written as with a common pen; taking care always to keep the copies parallel, and the legs stiff. The paper must be large enough to write all the copies at once, and, when done, they must be cut off. It is, indeed, practicable to write two copies at once, without any other means than holding two pens in one hand; but this is too difficult for general use.

The method generally used for writing several copies at once, by placing several leaves of thin white paper, and then of blackened paper, alternately, under each other, and writing, by strong pressure, with a point, which impresses the writing through all the pages, is, I believe, the best method hitherto adopted; but this might be practised with mine, united; and thus the number of copies be doubly multiplied.

A sort of pantigraph has been attempted for making two copies at once. Copying machines by pressure are also adopted. The first method, however, is complicated, and both of them are very limited in their operations; but could the object of writing several copies at once be easily effected, the advantage would undoubtedly be great.

I remain yours, &c.,

L. GOMPERTZ.

WILKES'S PARALLEL VICE.

To the Editor of the Penny Mechanic and Chemist.

Sir,—In Part 52 of the Penny Mechanic, I find an abstract of the specification of a patent of *Wilkes's Parallel Vice*, which appears to me very superior to any I have yet seen. Being in want of such a tool, I have made inquiry respecting this vice, but, hitherto, in vain. I shall feel greatly obliged to any of your numerous readers, who may be enabled to direct me where to procure a parallel vice of Mr. Wilkes's construction.

I remain yours, &c.,
An Amateur Mechanic.

THE CHEMIST.

NITROGEN AND HYDROGEN.

Nitrogen.—This gas is also called azote, from a Greek word, signifying privation of life. To obtain it, it is only necessary to burn phosphorus in a receiver, full of air, over water. The phosphorus, when lighted, combines with the oxygen, and forms phosphoric acid, which is absorbed by the water, and pure nitrogen remains. It is chiefly noted for its negative qualities. It is colourless, elastic, and devoid of all smell and taste. It appears favourable to plants, as they live and vegetate freely in it. It is neither a supporter of combustion, nor a combustible body itself. To prove this, immerse phosphorus in it, and also a lighted taper. It is a little lighter than common air. This is an excellent and wise provision of Nature; for, were it otherwise, it would gradually rise above our heads and stifle us. To show this, immerse tapers of different lengths under a glass jar, full of atmospheric air; the longest will go out first, and the shortest last; owing to the pure air occupying the lower portion of the jar. Animals breathe a small portion of this gas—namely, about four or five ounces every twenty-four hours—which enters into their body, and forms a constituent of it. It forms many valuable and curious compounds with the other bodies, many of which explode as it is separated.

Hydrogen.—This gas was discovered by Mr. Cavendish in 1776. It is the lightest of all ponderable bodies, weighing only one-fourteenth of our atmosphere. It is generally procured from water. To obtain it, mix, in a flask or retort, eight parts of water, with one of sulphuric acid, and some granulated zinc. The reaction is best explained by the following diagram;—

Water	Oxygen	Set free.
	Hydrogen	
Zinc.....		Oxide of zinc.
Sulphuric acid		Sulphate of zinc.

By this diagram it will be found, that the oxygen combines with the zinc, forming oxide of zinc. The use of the sulphuric acid is this:—When an oxide is once formed on the surface of the zinc, it prevents farther action; the sulphuric acid combining with the oxide, forming sulphate of zinc, which, falling down, presents a fresh surface for the water to act upon. By this way, however, it contains a portion of hygrometric water. To free it from this, it must be collected over mercury, and subjected to the joint action of dry muriate of lime and a low temperature. In this state its specific gravity is 0.0694. Dr. Ure shows that, by standing over water, its specific gravity acquires an increase of nearly one-seventh. The gas, when obtained in this state, is perfectly colourless, and has a slight garlic odour; when passed through alcohol, it renders it milky. This gas is not a supporter of combustion, but it is a highly combustible substance; it is the combustible basis of that pest of miners—the fire-damp. The formation of this, as well as the changes which occur when it is ignited, are best explained by the following diagram:—

Fire-damp ..	Atmospheric air	Nitrogen	Choke damp		
		Oxygen			
	Bihyduret of carbon	Oxygen.....	Water		Carbonic acid gas.
		Carbon			
		Hydrogen....			

Sir Humphry Davy entirely obviated the fatal effects of this gas, by his ingenious invention, the safety-lamp. This ought to be used in every mine, but, unfortunately, the owners of them think that it is better to lose human life than to spend a few pounds. The late fatal accident which has happened, would have been entirely obviated by the use of this lamp; and, I think, that something ought to be done to make the owners of mines use them.

If hydrogen gas be forced out of a bag with a small nozzle, upon a few pieces of

spongy platinum, at the distance of one or two inches, in order to allow the air to mingle with it, the platina is first made red-hot by the hydrogen, which it then inflames. This truly wonderful discovery was made by M. Dobereiner. If a stream of this gas be forced out of a bladder, with a nozzle to it (similar to that used in the last experiment), then lighted, and a small piece of glass tubing be held over the flame, in a short time it will be covered with moisture, and most harmonious sounds will proceed from it. It was at one time thought, that this depended entirely upon the moisture which was formed; but as this can also be produced by the action of carbonic oxide, it is supposed by Sir Humphry Davy to be nothing more than a continued series of explosions. On its effects upon the voice, I shall take an extract from "Tilloch's Magazine," vol. ix., page 214:—"Maunnier was one day amusing himself with Paul, at Geneva, by breathing pure hydrogen gas; he did not perceive that it had any effect on him, either in passing in or out of his lungs, and he inspired it with ease for a considerable length of time; at length he became anxious of speaking, and was astonishingly surprised at the sound of his voice, which had become soft, shrill, and even squeaking, so as to alarm him. Paul tried the same experiment upon himself, and it produced the same effect."

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, May 25, H. Brown, Esq., on the Phenomena of the Human Character. Friday, May 27, J. H. Lewis, Esq., on Historical Subjects, extracted from the Roman History. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, May 26, J. S. Buckingham, Esq., on the United States of America. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, May 26, J. S. Dalton, Esq., on Social Life in Ireland. At eight o'clock.

QUERIES.

A gentleman who is engaged on a work illustrative of the *lathe*, its construction and application, solicits communications from practical men, who may be in possession of facts and information not generally known, whether as regards the mechanical arrangement, or operative results of this machine. The Editor of the PENNY MECHANIC will take charge of, or direct any letters.

An easy way to fix photogenic drawings?

C. M.

The best method of magnetising bars of steel?

Y. Z.

ANSWERS TO QUERIES.

"W. R. N." The nicking of organ-pipes is requisite to throw the current of air in a steady stream; so that about half may enter the pipe, and half be thrown outside. This sets the column of air in the tube in vibration, and produces the tone. If "W. R. N." would take two pipes, one nicked and the other not, and blow into them, he would find the one produce a clear steady sound, and the other a faint, wavering, and unpleasant noise. Large pipes have a greater number of nicks than small ones in the same stop, but are nicked coarser, though regular. The number of nicks is not of any consequence, so that they are regular and tolerably close. Five minutes' inspection of pipes would explain more than an hour's reading.

I have not yet had an opportunity of ascertaining the expense of the principal and dulciana stops in metal for "An Amateur," but will do so shortly. His organ being only about eight feet high, would prevent his having a dulciana all through, as the C C of that stop is eight feet long in the speaking part alone, and the F below would be about twelve feet, besides the foot. He could, however, remedy the difficulty, by having the lower octave of stopped pipes, made on a small scale, and much softened.

If "W. H.," who proposes to make organ-pipes by the electrotype process, would examine a pipe, he would see the impossibility of making it in one piece; and, if not made so as to prevent the necessity of making a joint, he does away with the utility. In the next place, the size of some of the pipes would be a serious impediment; and, lastly, the expense would be at least ten times more than the ordinary way.

G. S., Jun.

TO CORRESPONDENTS.

L. Gompertz.—*We will take the earliest opportunity of inserting his papers on watches and clocks, railways, &c.*

R. Mordish.—*We have received his description of calotype drawing, but he will see that a similar one was inserted last week in answer to "G. S., Jun.'s" query.*

R. Hammond.—*We should be most happy to assist him, were it in our power. He will, perhaps, inform us to what kind of work he has been accustomed.*

An Old Subscriber.—*We are not at present aware of any particular method of bleaching shell-lac. Has he tried melting and exposing to the sun?*

W. S. S. *will find a receipe for lemonade powder in No. 26 of the last Volume.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.
A MAGAZINE OF THE ARTS AND SCIENCES.

Nos. 83 & 84, THIRD SERIES. | SATURDAY, MAY 28. PRICE TWOPENCE. | Nos. 331 & 332, OLD SERIES.

WATCHES AND CLOCKS WITHOUT CHAINS AND FUSEES.

FIG. 1.

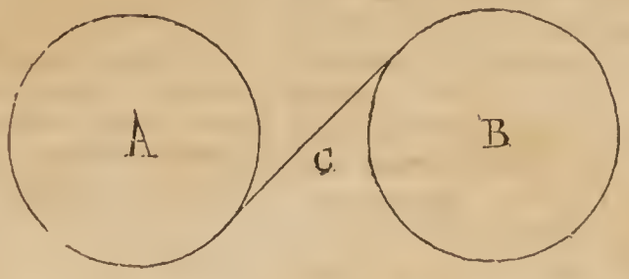


FIG. 2.

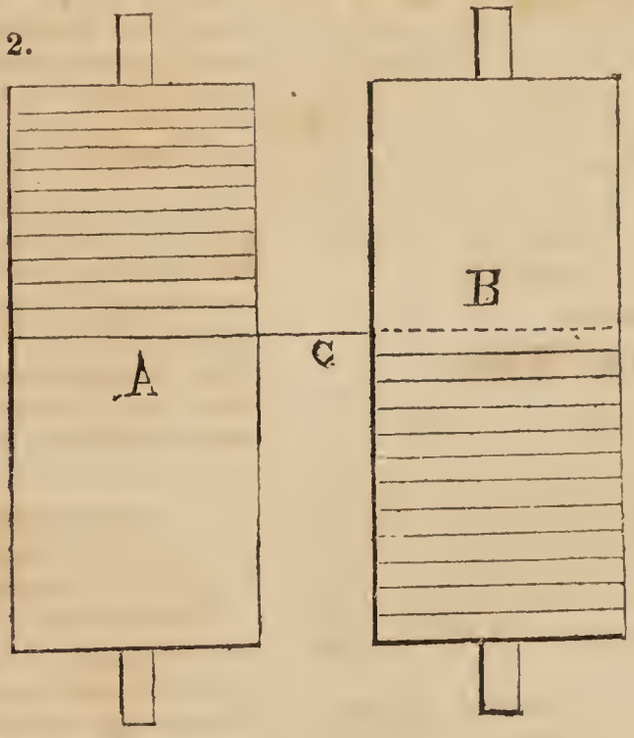
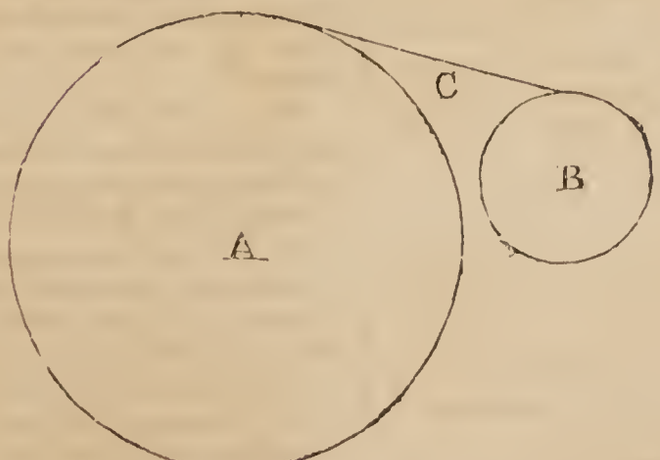


FIG. 3.



Vol. VIII.—Nos. 24 & 25.] City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

WATCHES AND CLOCKS WITHOUT CHAINS AND FUSEES.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—Though feeling reluctant to offer for your valuable work the following suggestion, yet, in the hope that it will be of some use, I will trust in the indulgence of your readers, and venture to explain it; it being a method to do away with the chain and fusee of watches and clocks, though the great ingenuity and efficacy of the present plan, render it almost a pity to supersede them, if possible; but, be that as it may, the following is my suggestion.

Description of the Engravings.

A B, figs. 1 and 2, are two cylinders, of equal size, turning on centres on the same ground or standard; and C is a spring, the natural position of which is circular, to fit one of the wheels (suppose A); this spring is then to be attached to each of the cylinders, in contrary sides of them but in such directions that, when they revolve, the spring works *on* the one cylinder and *off* the other, or *vice versâ*, but always keeping parallel. Suppose, then, the spring, whose natural curvature is that of A, be wound, by force, round B, in a contrary direction to its own curvature, it would then continually exert a force to unbend and wind round the other cylinder, always, if I am not mistaken, with equal force, and thus effect the object intended; though, it is to be feared, that some difficulty would sometimes be experienced in making so active a spring. But if such should be the case, the plan might be varied, so that the spring should bend in the same direction on both wheels or cylinders; in which case it would not go to opposite sides of the two wheels, but to the same, and then one of the wheels must be considerably larger than the other, as in fig. 3. Suppose, then, the spring be coiled up in a small curvature, and set in that bent; if one end be coiled round the large wheel, A, and the other end be attached to the small wheel, B, it will, by its own force, unwind from A, and wind on B, similarly to the last plan, though with less force; and, of course, both wheels would turn, as the spring regained its proper bent.

I remain yours respectfully,

L. Gompertz.

DYNAMICAL GEOLOGY.

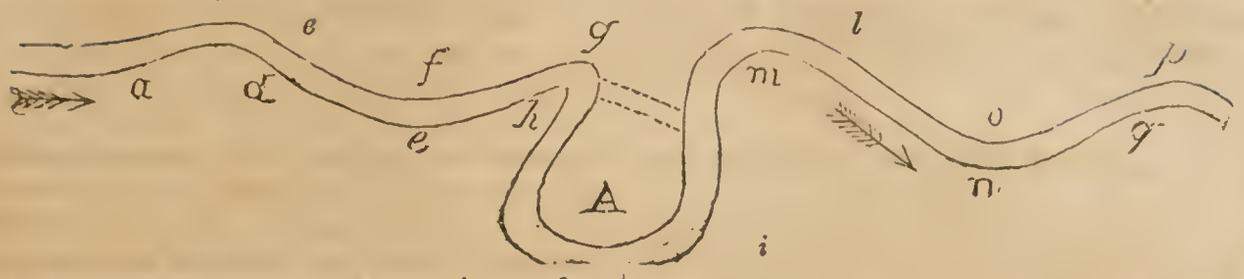
(Continued from page 181.)

RIVERS.

Almost from the very commencement, rivers exert great power, either in corroding chemically, or in mechanically grinding away the rock and soil through and over which they pass. The earthy materials, thus taken away, continue suspended in the water until favourable circumstances occur, when they are deposited, and thus augment the land. The wearing and transporting powers of rivers depend upon the volume of water, the quantity and size of the solid matter suspended, and the velocity with which it moves. A river generally runs with greatest rapidity in the highest parts of its course, where, indeed, it often consists of a succession of torrents and cataracts for many miles; but it has not yet acquired its full destructive force, because the mass of water is still comparatively small, nor has it yet become loaded with solid matter. In the lower part of its course, long before it joins the sea, it has usually reached a level country, and thus its velocity becomes greatly retarded. The Senegal, according to Adanson, does not fall more than two feet and a half from Podor to the sea, a distance of sixty leagues. The destructive force is thus lessened by the diminished velocity, and by the consequent inability of the stream to drag its heavy artillery along with it. It is, therefore, in the middle part of its course, that a river commits the greatest waste, after it has acquired a considerable volume, has become loaded with solid matter, and, from the inclination of the ground, still possesses power to wield its more mighty weapons of destruction.

The loss of destructive power by diminished velocity in the level country, is sometimes compensated, in a considerable degree, by the effects produced by the weight of the great volume of water impinging upon certain parts. This will be better understood by the annexed diagram.

When the river, in its oblique course at the entrance of the plain, strikes against the bank, *a*, it speedily forms a steep or vertical cliff, which turns off the water, in its downward course, into an opposite direction. The river now falls with its whole force against the point, *c*, which, in its turn, becomes precipitous, and deflects the water towards the point, *e*; and, in this manner, the process is repeated, at short intervals, producing a series of salient and re-entering angles.



The diagram represents a river after the process of erosion has considerably advanced; at first, its course would be much less tortuous. If the country be composed of rocks, both banks are usually steep; but, if the ground consist of loose materials, the spaces between the precitate parts of the banks—that is, between the salient angles—consist of flat alluvial land, with a gravelly bottom, the gradual creation of the stream. Sometimes the course of the river is so tortuous that two points, *h* and *m*, may be within a few hundred yards of each other, and yet, by following the stream, they may be some miles asunder. In this case, the narrow neck of land is acted upon doubly, for the force of the water is directed against it on each side. In time, this isthmus is breached, and the river either flows entirely through the new channel, or, dividing, forms the land, A, into an island.

I have chosen the following examples from among the many which have been collected by Mr. Lyell and others, to illustrate the great efficacy of rivers in wearing down the land. The rapidity with which even the smallest streams hollow out deep channels in soft and destructible soils, is remarkably exemplified in volcanic countries, where the sand and half-consolidated tuffs oppose but a slight resistance to the torrents which descend the mountain's side. After the heavy rains which followed the eruption of Vesuvius in 1822, the water, flowing from the Atrio del Cavallo, cut, in three days, a new chasm through strata of tuff and ejected volcanic matter, to the depth of twenty-five feet. There are also many striking examples of the gradual erosion of deep chasms through some of the hardest rocks, by the constant passage of running water charged with foreign matter. For instance, a stream of lava, poured out from Etna, in 1603, flowed across the bed of the Simeto, the largest river in Sicily, which flows along the base of the mountain, and falls into the sea near Catania. The stream has now cut a passage through the hard rock, which is only a little less compact than basalt, to the depth of about fifty feet, and from fifty to several hundred feet wide. The Nerbudda, a river of Hindostan, has worn a channel in a basaltic rock, near Jubbulpoor, to the depth of 100 feet. Messrs. Sedgwick and Murchison state, that in the conglomerate found in many of the eastern Alps, rivers have often scooped out gorges to the depth of 600 and 700 feet.

Let us now turn our attention to the *transporting* powers of rivers. On this subject we shall meet with some valuable remarks in Mr. De la Beche's work on "Theoretical Geology." It is there stated, that a velocity of a stream of tide of three inches per second at the bottom,* will just begin to work upon fine clay, fit for pottery; and, however firm and compact it may be, it will tear it up. A velocity of six inches will lift fine sand; eight inches will lift sand as coarse as linseed; twelve inches will sweep away fine gravel; twenty-four inches will roll along rounded pebbles an inch in diameter; and it requires three feet per second at the bottom, to sweep along stones of the size of an egg.

Of course, it is in times of floods, that rivers both gather the most materials and transport them farthest.† A flood, that happened in the north of Scotland in 1829, afforded numerous examples of the power of running water to transport large blocks of stone. On the river Nairn, a fragment of sandstone rock, fourteen feet long, by three feet wide and one foot thick, was carried above 200 yards down the river. The small rivulet, called the College, at the foot of the Cheviot Hills, Northumberland, in 1827, carried several masses of stone, weighing from half to three-quarters of a ton, two miles down its course; a large block, weighing two tons, was transported to the distance of a quarter of a mile.

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* It has been proved by experiment, that the rapidity at the bottom of a stream is everywhere less than in any part above it, and is greatest at its surface. Also, that in the middle of the stream, the particles at the top move swifter than those at the sides.

† It has been computed, that, in some instances, the water of a river in a flood, contains earthy matter suspended in it, amounting to more than the 250th part of its own bulk.

HISTORY AND PROGRESS OF THEORETICAL AND PRACTICAL MECHANICS.

No. V.

In his "Traite des Isoperimetries," printed at Lausanne, in 1744, Euler extended the principle of least action, and showed, "That in the trajectories described by means of central forces, the integral of the velocity, multiplied by the element of the curve, is either a maximum or a minimum." This remarkable property, which Euler recognised only in the case of insulated bodies, was generalized by Lagrange into this new principle, "That the sum of the products of the masses by the integrals of the velocities, multiplied by the elements of the spaces described, is always a maximum or a minimum." In the "Memoirs of Turin," Lagrange has employed this principle to resolve several difficult problems in dynamics; and he has shown, that, when it is combined with the conservation of active forces, and developed according to the rules of his method of variations, it furnishes directly all the equations necessary for the solution of each problem, and gives rise to a simple and general method of treating the various problems concerning the motion of bodies.

An important discovery in rotary motion was, at this time, made by Professor Segner. In a paper entitled, "Specimen Theoriæ Turbinum," he demonstrated, that, if a body of any form or magnitude, after it has received rotary motions in all directions, be left entirely to itself, it will always have three principal axes of rotation; or, in other words, all the rotary motions with which it is affected, may be reduced to three, which are performed round three axes, perpendicular to each, passing through the centre of gravity of the revolving body, and preserving the same position in absolute space, while the centre of gravity is either at rest, or moving uniformly in a straight line.

The force of torsion began at this time to be investigated by Coulomb, who published two ingenious papers on the subject, in the "Memoirs" of the French Academy. He has successfully employed this principle in several physical researches, but particularly in determining the law of magnetic action, and in finding the laws of the resistance of fluids, when the motions are extremely slow. It was by means of an elegant experiment on the principle of torsion, that Mr. Cavendish determined the mutual attraction of two masses of lead, and thence deduced the mean density of the earth. We are also indebted to Coulomb for a complete set of experiments on the nature and effects of friction. By employing large bodies and ponderous weights, and conducting his experiments on a large scale, he has corrected errors which necessarily arose from the limited experiments of preceding writers. He has brought to light many new and interesting facts, and confirmed others which had hitherto been partially established. The most curious result of these experiments is, the effect of time in increasing the friction between two surfaces. In some cases, the friction reaches its maximum after the rubbing surfaces have remained in contact for one minute; and, in other cases, five or six days were necessary before this effect was produced. The increase of friction, which is generated by prolonging the time of contact, is so great, that a body, weighing 1650 lbs, was moved with a force of 64 lbs. when first laid upon the corresponding surface. After remaining in contact for the space of three seconds, 100 lbs. were necessary to put it in motion; and, when the time was prolonged to six days, it could scarcely be moved with a power of 622 lbs.

One of the most important treatises on the science of motion, is the "Mechanics" of the celebrated Euler, published in 1736. It contains the whole theory of rectilineal and curvilineal motion in an insulated body, affected by any accelerating forces, either in vacuo or in a resisting medium. He uniformly uses the analytical method, and has employed the principle of the *vis inertiæ*, and that of compound motion, for putting his problems into equations. By the *vis inertiæ*, motion is, at every moment of time, rectilineal and uniform; and, by the principle of compound motion, a body, exposed to the action of any number of forces, tending to alter the quantity and the direction of its motion, will move in such a direction as to reach the very point at which it would have arrived, had it obeyed successively each of the forces which act upon it. In the "Mecanique Analytique" of Lagrange, published in 1788, all the mechanical problems are reduced to general formulæ, which, being developed, furnish us with the equations that are necessary for the solution of each problem; and the different principles which have been discovered for facilitating the solutions of mechanical questions, are brought under one point of view, and their connexion and dependence clearly pointed out. The "Architecture Hydraulique," by M. Prony, published in 1790, and the "Mecanique Philosophique" of the same author, published in

1799, contain all the late improvements in mechanics, and a complete view, both of the theory and application of that science. The first of these works is intended chiefly for the use of the engineer, though an extensive acquaintance with the higher geometry is necessary for perusing it with advantage. His "Mecanique Philosophique" is a profound work, in which, without the aid of a single diagram, he gives all the formulæ, and the various theorems and problems which belong to the sciences of mechanics and hydrodynamics. Every alternate page contains a methodical table of the results obtained in the preceding page, the description of the symbols, and the theorems, problems, and formulæ which may have been obtained. The "Traité de Mecanique Elementaire," by M. Franceur, published in 1802, is an excellent abridgment of the works of Prony, and is intended as an introduction to the "Mecanique Philosophique" of that author, to the "Mecanique Analytique" of Lagrange, and to the "Mecanique Celeste" of Laplace. None of these works have been translated into English; but their place is well supplied by a "Treatise on Mechanics, Theoretical, Practical, and Descriptive," by Olinthus Gregory, A. M., published in 1806, and containing a complete view of the latest improvements, both in the theory and practice of mechanics.

LATHE-DIVIDING PLATE.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I beg leave to say, that my objection to "Amateur Mechanic's" improvement on a "Lathe-dividing Plate," was not urged so much from any other motive, as with a view to remedy the defect which I pointed out, and which even "A. M." himself admits to exist, by his recommending precautionary measures in the same article; and, farther, I beg to say, that I have occasion daily to use the wheel and screw, for the purpose of obtaining circular division, and, therefore, have ample opportunity of experiencing the defect alluded to.

Certainly I agree with "A. M.," that a "large wheel," "cast in proper metal," "the screws hardened," &c., and, I may add, a "V, instead of a square thread," "and, at the same time, adopting the plan of suspending the screw, with its frame, upon centres" (recommended by me in No. 70, page 84), are all circumstances that would tend to reduce the evil complained of; but still these are all admissions that a defect does exist in the principle.

In the same Number, "A. M." wishes to obtain directions how to cut the edge of a plate for a tangent-screw to work. I beg to say, that I will give him all the instruction my humble abilities will allow, if he will furnish his residence, or how I am to communicate with him; as it would require that I should be very explicit, being a job of great nicety. I am aware that "W. H." has given two plans, but the one would be expensive ("A. M.," perhaps not being in possession of the requisite apparatus), and the other would not only be tedious, but there would be no dependence upon it as regards truth; but the plan I would recommend, would be of little trouble or expense, and could be depended upon, inasmuch, that it would correct its own inaccuracies.

Allow me, in conclusion, to remark, that I, and, no doubt, others of your correspondents, cannot but feel delighted at noticing the unhesitating manner in which "A. M." and others have contributed to your pages anything which has appeared to them to be for the public good, and which it has been in their power to supply: it is alike honourable to them as correspondents, and to yourself as Editor; proving that your labours have not been undeserving.

I remain yours, &c.,

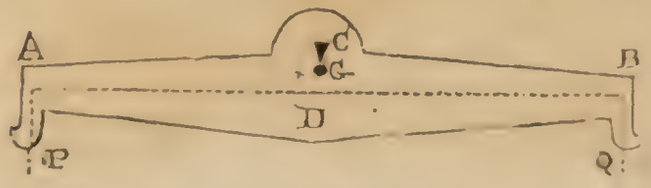
A. B.

THE BALANCE.

The instrument most commonly known by the term balance, is a superior sort of scales, executed with all the precision necessary for the nicest operations of physics, and particularly of chemistry. The following are the circumstances which are necessary to a good performance of a philosophical balance:—A simple straight lever, balanced by weights resting immediately upon it, so that the centre of gravity falls on the fulcrum, is at rest in every position; for no motion will change the position of the centre of gravity. A beam, so constructed, will make equal weights appear unequal; in order, therefore, for a balance to perform well, it should, in the first place, be *sensible*; meaning that, when poised, a very small addition of weight to either scale should make it turn—that is, overcome the necessary friction and adhesion of the pivot or knife-edge on which it rests. If there were no friction, the smallest weight would make it turn. The first condition of sensibility,

therefore, is the diminution of friction to the utmost possible extent. This is done by making all the parts of a high polish, and by placing the beam upon the support, by means of knife-edges attached to its sides.

A balance should also be stable—that is, should, on being disturbed, immediately return, and oscillate about the position of rest. This is done by making the centre of gravity of the whole apparatus fall below the point of support. But as stability is not so difficult to attain as sensibility, the latter must be most attended to. The scales in the shops are sufficiently stable, but few are very sensible. Neglecting the particular nature of the method of support, and circumstances of mere conformation, the balance may be represented as follows:—C is the point of



support, showing a section of one of the knife-edges, which rests upon a smoothly-polished plane; G, the centre of gravity of the whole beam; A and B, the points of suspension of the scales; D, the point of coincidence of A B and C G. The stability of two balances is thus compared:—Suppose that the same small disturbance be given to both; then if the force with which the first endeavours to recover its position, be double or triple that of the second, the stability of the first is double or triple that of the second. To compare these forces, construct the following formula for both:—

To weight of both scales × C D, add weight of the beam × C G; for instance, suppose two balances as follows:—

	First.	Second.	
Arm, A B	12	.....	14 inches
C D	2	.....	3
C G	1	.....	2
Weight of beam..	30	.....	50 ounces
Ditto, both scales	24	.....	30

Then will the stabilities of the first and second be as $24 \times 2 + 30 \times 1$ to $30 \times 3 + 50 \times 2$, or as 78 to 190.

The sensibility is estimated by comparing the angles through which very small equal weights would incline the balances. If, for example, a grain put into a scale of each, incline the first four degrees, and the second only two degrees, the first is twice as sensible as the second. To compare the sensibilities, multiply the length of the arm of each by the number which represents the stability of the other, in the formula just given. Thus, the sensibilities of the preceding balances are as 12×190 to 14×78, or as 2280 to 1092.

It would not be worth while to work very accurately by the preceding formula, but the general rules deducible from them are valuable.

1. Other things remaining the same, the longer the arm, the greater the sensibility.

2. The arm having a given length, every increase of sensibility is a decrease of stability, and *vice versâ*.

3. Additional weight, either to the scale or beam (the arm remaining the same), is favourable to stability and unfavourable to sensibility.

4. Whatever does not alter the length of the arm, cannot be favourable to both.

In all that precedes, it must be recollected that in the weight of the scales is included whatever may happen to be in them; consequently, every balance has different degrees of sensibility and stability, with the different weights which are employed. But as, generally speaking, the quantities weighed in delicate balances are small; a balance which is highly sensible when no weight is in the scales, will be so for every weight with which it is intended to use it. A balance made by Ramsden for the Royal Society, weighing ten pounds altogether, turned with the ten-millionth of that quantity, or about the thousandth part of a grain. In some balances a needle is attached to the beam, which points either exactly upwards or downwards, when the beam is horizontal. A graduated scale of degrees is attached to the framework of the instrument in such a manner, that the needle may point to zero when it is vertical. The oscillations of the balance, when the centre of gravity is near to that of suspension, will be very slow; and by means of the needle it may be ascertained before the balance comes to rest, whether horizontal equilibrium has been obtained: for in that case it will describe equal arcs on the graduated scale on each side of the zero point; while if either scale be overloaded, the needle will move through more degrees on the side of that scale than on the other.

All that precedes has reference to the theoretical construction of the instrument, and supposes that a perfect balance can be made, so that equal weights shall counterpoise each other. This is certainly impossible in practice, though one balance may be nearer than another. The

following simple method, imagined by Borda, overcomes this difficulty, provided only the balance be sensible and very well constructed at the knife-edge. Instead of weighing, say a portion of salt against brass weights, weigh both the salt and the weights against some third substance, say, for distinction, iron weights, as follows :—Call the scales A and B ; weigh the salt in A against iron weights in B, till there be a counterpoise; then remove the salt, and substitute the brass weights in A until there be again a counterpoise. It is now of no consequence whether the weight of iron was equal to that of the salt or not; the weight of the salt and of the brass must be the same, because, under the same circumstances, the two counterpoise the same weight of iron.

E. L.

THE NEW POSTAGE ENVELOPES.

Few of our readers can possibly conceive the extent of business carried on in envelopes, in consequence of the recent alteration in the postage of letters. We had lately an opportunity of inspecting the premises and machinery of one of the manufacturers of envelopes — Marc Lariviere, of London Fields, Hackney, who has long been justly reputed for his skill in the art of perforating cards, window-blinds, &c., of which he was the original inventer and patentee, which present designs of the richest and most extensive variety. By machinery, which Marc Lariviere has lately introduced for cutting and folding envelopes, he is enabled to produce, without any apparent effort, the enormous number of 200,000 envelopes per day; and so extensive is his consumption, that we have been informed by our printer, he has just executed an order of one description of wrapper, which will be sufficient to cover 15,000,000 of envelopes!

RAILWAY IMPROVEMENT.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I beg to solicit your attention to an invention of mine, which, I think, an improvement on the present railways; seeing the very great inconvenience which is caused by the inclined planes, of which, unavoidably, there are so many on the present railways.

My invention consists in the inner edge or flange, which keeps the wheel on the rail of power wheel of the steamer, being rather deeper than any other, and, likewise, cogged or toothed, which will catch on a smaller rail likewise cogged, set lower in, or rather on, the ground; so that, while the steamer has all the power of a cogged wheel, none of the other carriages are in the least affected by it.

I remain yours, &c.,

S. T. R.

ROYAL COMMISSION OF FINE ARTS.

An advertisement has been issued by the "Commissioners appointed by the Queen, for inquiring whether, on the rebuilding of her Majesty's Palace at Westminster, wherein her Parliament is wont to assemble, advantage might not be taken of the opportunity thereby afforded, of promoting and encouraging the fine arts in the United Kingdom; and, secondly, in what manner an object of so much importance might be most effectually promoted;" which advertisement announces that they "have resolved, that it would be expedient, for the farthering of the objects of their inquiry, that means should, in the first place, be taken to ascertain whether fresco painting might be applied with advantage to the decoration of the Houses of Parliament." This announcement (says the *Art Union*) is sudden and startling; but it is also very gratifying and highly satisfactory. It is a proof that the country has been roused in earnest; and that the fine arts in Great Britain are, at length, to be aided by the British nation. The document is honourable to the Commissioners. It was utterly impossible to have produced one more distinct, more comprehensive, or more satisfactory, in all respects. It contains two passages especially cheering and encouraging: they are these:—1st. "The competition will be confined to British artists. 2nd. Her Majesty's Commissioners will announce, at a future period, the plan which they may adopt in order to decide on the merits of candidates for employment as oil-painters and as sculptors." Now the most ardent advocates for paintings in oil, and the most strenuous opponents of works in fresco, cannot, and, we believe, do not, object to ornamenting parts of the new Houses of Parliament in a style *new*, generally speaking, to British artists, but excellence, in which they are surely as capable of achieving as any of the painters of Germany, Italy, or France. There can be no question that the parts, so embellished, will be such as are particularly suited for fresco, and comparatively un-

suited for any other style. We cannot doubt, that the same sound judgment and good taste, by which the Commissioners appear to have been hitherto guided, will be exercised in all their decisions and upon all their arrangements. The artists and the public have confidence in the Commissioners and in their accomplished and upright Secretary, who, they will readily believe, has not been an idle looker-on or an indifferent spectator, when the reputations and interests of his brethren were at stake. It would be indelicate to say more upon this subject; but it would be unjust to say less. That confidence is now extended and confirmed, the Commissioners have entitled themselves to the gratitude of the profession and of the British people; and the Royal Prince, who is at the head of them, has established a new claim upon the affection of the nation. His Royal Highness Prince Albert has attended every meeting of the Commissioners that has yet been held, and takes the warmest interest in the proceedings.

CONDITION OF CHILDREN IN THE COAL MINES.

In the present article, we propose introducing to the notice of the public some of the results of a commission appointed to investigate the condition especially of children in the mining districts. The greater part of the report is naturally occupied with the coal mines, and we shall confine ourselves to these in the notice we take of it. Our extracts from the evidence gathered by the Sub-Commissioners will be better understood, if we begin by explaining to our readers what are the different kinds of work which a collier is called upon to perform. Coal is not found in solid masses of half-a-mile cube, but in veins or layers of various thickness, which have to be pursued by the miners, extracted bit by bit, and sent up to the surface. Through each of these layers at least one principal passage is run, sometimes called the main-gate; from this the subordinate passages are pushed out on each side, if advisable, into the coal; and the mineral, as it is broken out, is sent along the "side-gates" into the "main-gate," along the "main-gate" to the bottom of the shaft, and up the shaft to the surface. Further, all these passages, as every one knows who has heard of fire-damps and black-damps, require to be well ventilated if the lives of the men are to enjoy even that very limited security which is possible in a coal mine. For this purpose an apparatus of doors is required, in order to conduct the draught of air through the complicated system of passages of which the mine is composed, even to its most remote extremities. Through these the barrows or waggons (corves, as they are called) of coal have to pass; and it is necessary, for the safety of those who work deeper in the mine, that no time should be lost in shutting up the door or "trap" when they have passed. The person who is stationed there for this purpose, is called a "trapper." Those who actually work their way into the body of coal with their pickaxes, are called "getters" or "holers;" those who push or drag it in the "corves" along the different passages, are called "hurriers" or "putters." The least laborious of these occupations is plainly that of trapper; and that accordingly is committed exclusively to children. As we shall proceed to give specimens of the more cruel employments to which these poor creatures are condemned under-ground, it will be but fair to their employers to exhibit this the most attractive side of the picture:—

"The trappers sit in a little hole scooped out for them in the side of the gates behind each door, where they sit with a string in their hands attached to the door, and pull it open the moment they hear the corves at hand; and the moment it has passed, they let the door fall to, which it does of its own weight. If anything impede the shutting of the door, they remove it, or, if unable to do so, run to the nearest man to get him to do it for them. They have nothing else to do; but as their office must be performed from the repassing of the first to the passing of the last corve during the day, they are in the pit during the whole time it is worked, frequently above twelve hours a-day. They sit moreover in the dark, often with a damp floor to stand upon, and exposed necessarily to draughts. It is a most painful thing to contemplate the dull dungeon-like life these little creatures are doomed to spend—a life, for the most part, spent in solitude, damp, and darkness. They are allowed no light; but sometimes a good-natured collier will bestow a bit of candle upon them as a treat. On one occasion, as I was passing a little trapper, he begged me for a little grease from my candle. I found that the poor child had scooped out a hole in a great stone, and, having obtained a wick, had manufactured a rude sort of lamp, and that he kept it going as well as he could, by begging contributions of melted tallow from the candles of any Samaritan passers-by. To be in the dark

in fact, seemed to be the great grievance with all of them. Occasionally they are so posted as to be near the shaft, where they can sometimes run and enliven themselves with a view of the corves going up with the coals, or perhaps occasionally with a bird's-eye peep at the daylight itself. Their main amusement is that, however, of seeing the corves pass along the gates at their posts. When we consider the very trifling cost at which these little creatures might be supplied with a light, as is the case in the Cumberland collieries, there are few things which more strongly indicate the neglect of their comfort than the fact of their being kept in darkness, of all things the most wearisome to a young child." (p. 71.)

But to proceed : when the layers of coal are thick, say six or seven feet, the work is simple enough. The "getter" uses his pickaxe and his gunpowder freely as he would against the side of a rock, and the coal is drawn by horses, or, if the layer (or "seam") be rather thinner, and the gallery in consequence somewhat lower, by ponies or asses, to the foot of the shaft. But often this is not the case. These seams of coal are sometimes no more than three feet, or two feet and a half in depth, and this has to be extracted, for the length and breadth of perhaps some hundred yards, from between two parallel strata of unprofitable rock. Where this is the case, the true cruelties of the mines are usually to be sought. The picture of the "getter" himself is not inviting—working his way slowly onwards for a hundred yards together, in a lying or sitting posture, in an atmosphere of black dust, varied by the different noxious gases with which the place is fertile—in utter darkness, except to the extent of his single candle, very commonly quite naked, and in entire solitude, except while loading the "corve" which his "hurrier" brings to be filled. But it is this "hurrier" who is the real slave. Let any one conceive the occupation of dragging loads of coal for twelve hours together, almost without intermission, up and down hill (for the layers are not generally very level), often through water or coal mud some inches deep, along these dark passages, four, three, or even two and a half feet high—nay, "at times no more than eighteen or twenty inches" (p. 67)—places where it is obviously impossible ever to stand upright, and where a great part of the work must be performed by the hurrier creeping on his hands and knees, which, says one witness, become sometimes "almost hoofed" from the process. Will it be believed that this is the work which is especially allotted to *boys and women*? And at what age will it be supposed that children are carried down into the pits to be harnessed to their loads of coal? In some parts of the country, children commonly of eight and nine, and often of between six and seven years old, are employed in this painful and laborious task. Nay, worse (p. 14), William Ellis "had hurried ever since he was five (!!) years old." Hiram Stephenson, aged fifteen, "has been a hurrier *ten years and more*." Mr. Isaac Clayton, "agent and principal" in one of the mines, states that he "has known children admitted as hurriers as young as six ; *it is rare* to find them younger."

Extracts from the report will best show the kind of work which these poor children are employed in :—

"I wish," says the Sub-Commissioner, "to call the attention of the Board to the pits about Brampton. The seams are so thin that several have only a two-feet headway to all the workings. The pits are altogether worked by boys ; the elder one lies on his side, and in that posture holes and gets the coal. It is then loaded in a barrow or tub, and drawn along the bank to the pit mouth, without wheels, by boys, from eight to twelve years of age, on all-fours, with a dog-belt and chain, the passages being often an inch or two thick in black mud, and neither ironed nor wooded. In Mr. Barnes's pit these poor boys have to drag the barrows, with one cwt. (one of the witnesses says one and three-quarters) of coal or slack, sixty times a day, sixty yards, and the empty barrows back without once straightening their heads, unless they choose to stand under the shaft, and run the risk of having their heads broken by a coal falling" (p. 70).

And we may add, of getting well licked by their bigger companions for idling. This is principally drawn from the statement of the witness above alluded to, whose cool comment is, that, if they did not begin betimes, they could not work these narrow seams ; their limbs could not get used to it ; he thinks lads like it as well as when there is more room—he knows he did." Finally, "the pit would not pay to work any other way." The consequences however to the children are not so enviable. "Out of five children I examined," says the Sub-Commissioner, "who worked in the Brampton pits, three were not only bow-legged, but their arms were bowed in the same way, and their whole frame appeared far from being well developed."

CAUSE OF STEEL TURNING BLUE.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Having observed an article in your valuable Magazine, some few weeks back, by "Mr. Bilbrough" on the cause of steel turning blue, and being well convinced that the theory which he asserts, is erroneous, I take the liberty of offering a few remarks which, I trust, will be sufficient to convince him of his error.

I am well aware that one of your correspondents ("T. Reeves") has written several times on this subject, endeavouring to point out its absurdity; but however far I may agree with "T. R." in that respect, I must say that I think the course he adopted was but ill calculated to prove its fallacy.

Now both your correspondents admit that the blue colour on steel is caused by oxygen, which steel has the property of absorbing at high temperatures, and which consequently forms a coating of oxide on its surface, producing the blue colour before alluded to. Your correspondents therefore differ only as to the source from which the oxygen arises. Now "Mr. Bilbrough" asserts that the oxygen does not arise from the atmosphere, as stated by chemists, but actually attempts to prove that it is evolved from the steel itself. Now chemists are well aware that steel does not contain oxygen, steel being a compound of iron with carbon. That oxygen therefore can be evolved from a body which does not contain it, is of course an impossibility, and which "Mr. Bilbrough" cannot, I should think, attempt to deny. It is quite evident therefore, that "Mr. Bilbrough" advanced his opinion, and endeavoured to combat with the experience of scientific men, without so much as knowing what steel was composed of.

"Mr. Reeves" ought to have pointed out this primary source of error, as well as suggesting experiments to prove that the oxygen came from the atmosphere; if he had done so, it would have settled the dispute at once, and I am convinced that "Mr. Bilbrough" would no longer have maintained such an erroneous idea.

I sincerely hope that neither of your correspondents will take my remarks as offensive; for I wish not to create ill-feeling, but merely to correct that which is wrong.

I remain yours, &c.,

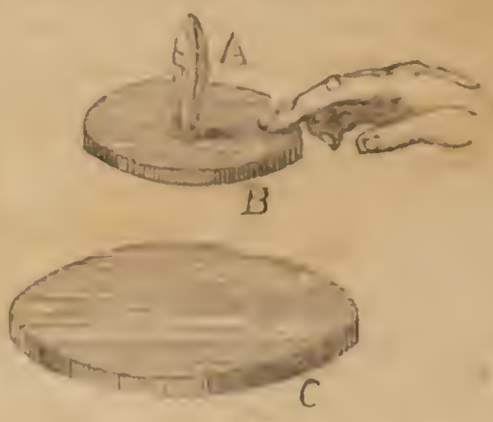
A. Taylor.

TO MAKE AN ELECTROPHORUS.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I think if "W. Courtney" will make an electrophorus in the following manner, he will be able to get the electric spark from it:—

The handle, A, is of glass, and is fixed



to the circular plate, B, made of block-tin, wired at the edge. For the lower plate, C, get a circular board, turned of any hard wood that will not warp, about half-an-inch thick; then melt in a ladle several ounces of common sealing-wax, and pour it, in a liquid state, over one side of the wood, so as to cover it completely. Make the surface level by heat: a hot smoothing iron, held at a little distance over it, answers admirably. Coat the opposite side of the wood with tinfoil, and the work is complete. To put it in action, take a piece of warm flannel and rub, *con spirito*, the sealing-wax; then place upon it the tin plate, holding it by the handle. Touch the plate with the finger (it will not do without), as represented in the sketch; take the finger off, and then raise the plate by the glass handle, and it will give out a strong spark, which may be communicated to a Leyden jar.

RULES FOR A MUTUAL-INSTRUCTION SOCIETY.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Enclosed is a copy of the "Rules, &c., of a Mutual-Improvement Society," of which I was a member some time ago, in hopes that it may present suggestions to persons about to form similar institutions; the one in question having been taken from the perusal of the laws of the Colebrook Dale Society, inserted in one of your back Numbers.

It is my intention, if possible, to form a Society of the kind, in the neighbourhood of King's Cross. I have already six gen-

tlemen's names, and have a large room in view, suitable for the purpose.

I remain yours, &c.,

F. J. C.

Declaration.

The object of the Institution being mutual instruction in general knowledge, with a class for dancing attached, as a recreation, the laws will be framed in accordance.

Section 1.—*Subscriptions.*

Law 1. That the subscription of members be, in proportion to the number, adequate to the current and general expenses of the Institution, as arranged at the general assembly of members.

2. That each class defray the special expenses appertaining.

3. That all money subscriptions be paid in advance.

Section 2.—*Admission of Members.*

Law 1. That all persons desirous of becoming members of the Institution, shall, upon the recommendation of any two members, have their names entered as candidates.

2. That all candidates, prior to their admission as members, pass a probationary term of one month; during which term, such candidates will, upon the payment of the usual subscriptions, be entitled to all the rights and privileges of members, except voting; upon the expiration of which, the decision of the members will be taken as to their admission as members. The candidates will be received probationary, by the verbal consent of the majority of the members present. The candidates will not be present on the evening of decision.

3. That all persons, on their election, be subject to a levy, at the discretion of the members in general assembly.

4. That in all members in arrears of subscription, the right of voting be suspended.

5. That all members in arrears of two weeks' subscription, be considered as having withdrawn themselves from the Society, and their names erased accordingly.

6. That, with the exception of the female friends of those members composing the class for dancing, no person—except members or persons whose services the classes or Institution may require—be admitted to the rooms.

Section 3.—*Arrangement of Classes.*

Law 1. That the following arrangement of classes be established:—

That Monday evening be appointed for the meeting of the class for dancing.

Tuesday—Mutual Instruction by reading essays.

Wednesday—English grammar class.

Thursday—Appointed for dancing.

Friday—Essays on general subjects.

Section 4.—*General Business.*

Law. 1. That Saturday evenings be appointed for transacting the general business of the Society.

2. That all notices given, or motions made, by members, be between the hours of nine and ten, on the evenings of general business.

3. That all motions be made, or notices given, two evenings of general business previous to decision.

4. That all motions or notices on the books, be read by the secretary every evening of general business, between nine and ten o'clock.

5. That no decision of members be taken before ten o'clock.

6. That all questions be decided by ballot.

Section 5.—*Secretary.*

Law. 1. That a secretary be appointed quarterly, who will superintend all receipts and disbursements under order of the members in council.

2. That the accounts be audited at the termination of the secretary's appointment.

Section 6.—*Laws.*

Law. 1. That should any temporary departure from the established laws be at any time advisable—being in strict accordance with the Society's declaration—the members in general assembly have power to make such temporary arrangement.

2. That the respectability of the Institution, and the comfort of the members generally, require that no fermented liquors or smoking be introduced.

3. That the business of each evening terminate by eleven o'clock, and on no account extend beyond.

The above has stood the test of a practical working, and was found to answer exceedingly well.

THE CHEMIST.

AMMONIA.

PURE ammonia is an aëriform or gaseous body, and was long supposed to be a compound of hydrogen and nitrogen, rendered gaseous by the addition of caloric; but, from the experiments of Mr. Davy on the alkalies, it appears to be a metallic oxide.

Ammonia gas has a strong and very pungent odour. It extinguishes flame, yet it increases the magnitude of the flame of a taper before extinction, producing a pale yellow colour round its edge. Animals cannot breathe it without death ensuing. It is lighter than atmospheric air, in the proportion of three to five. It tinges yellow vegetable colours brown, and blue ones green. It is rapidly absorbed by cold water; by ardent spirit, essential oils, ether, charcoal, sponge, bits of linen cloth, and all porous bodies.

When a piece of ice is brought in contact with this gas, it melts and absorbs the gas, while, at the same time, its temperature is diminished. It has no effect upon oxygen gas while cold; but, when made to pass with it through an ignited tube, it detonates and becomes decomposed. The same is the case with common air. It is also decomposed by phosphorus at high temperatures.

It does not explode when mixed with hydrogen gas. Nitrogen gas has no effect upon it. Atmospheric air does not combine with it at common temperatures, but only mixes with and dilutes it. When made to pass through ignited charcoal, it forms with it a substance called prussic acid. If brought into contact with acid gases, both gases lose their gaseous form, and become concrete. It has no sensible action on earths, or on the salino-terrene substances. It combines readily with acids, and unites to sulphur, when both are in a state of vapour. It reduces oxides of metals to their metallic state, and is decomposed by them. It is also decomposed by electrization, and by oxygenated muriatic acid gas, &c. When exposed to the temperature of forty-six degrees, it crystallizes, and when suddenly cooled down to sixty-eight degrees, it assumes a gelatinous appearance, and has scarcely any odour.

To obtain Ammonia. — Mix together equal quantities of muriate of ammonia and quicklime, separately powdered; introduce them into a gas-bottle or retort, apply the heat of a lamp, and receive the gas over mercury.

Muriate of ammonia consists of muriatic acid and ammonia; on adding lime to it, a decomposition takes place, the muriatic acid quits the ammonia and unites to the lime, in order to form muriate of lime, which remains in the retort, and the ammonia flies off in the state of gas.

In order to obtain the gas in a state of purity, it is essentially necessary that a considerable quantity of the gas first disengaged, be suffered to escape, on account of the common air contained in the distilling vessel and in the interstices of the ingredients.

Ammonia may likewise be obtained by heating the liquid ammonia of the shops in a retort, placed in communication with the mercurial pneumatic trough.

In this process, the ammonia contained in this liquid combines with caloric, assumes the form of ammonia gas, and parts with the water to which it was united.

The temperature of the fluid must not be carried so high as to cause the water to be converted into vapour; or, if this cannot well be avoided, a small vessel should be interposed between the retort and the receiver, which, when kept cool, may serve to condense the aqueous vapour which is formed, and cause the ammonia gas to pass in a very pure and dry state.

Ammonia is likewise produced during the spontaneous decomposition of animal and vegetable substances; in these cases it did not pre-exist in them ready formed, but is generated by the union of the hydrogen and nitrogen contained in them.

In combination with water, this alkali forms a solution of or liquid ammonia, which is called

Liquor Ammoniæ.

Take of muriate of ammonia, lime newly prepared, of each two pounds; water, a pint and a half. Reduce the muriate of ammonia and the lime into powder separately; then mix them, and introduce them into a large glass retort, into which a pint of water has been previously poured. Having placed the retort in a sand bath, lute on a tubulated receiver, through which the ammonia may pass on into a third vessel containing half-a-pint of the water, and cooled. Then at first apply a gentle heat, and increase it by degrees, until the retort becomes red.

Great care and attention are necessary in every part of this process; the two salts are to be powdered separately, before they are mixed; for, if they be triturated together, ammonia will be extricated, which should be prevented, until the means for its collection are adopted. The salts are to be shaken well together, rather than

rubbed, and added to the water in the retort. The cold produced by the solution of the salt, will counteract the heat produced by the slacking of the lime, and a charge, so made, will be manageable until the receiver is fitted on, and the heat of the sand bath applied. This heat need not be greater than 300°, and should be very cautiously and slowly raised, to prevent the rapid ebullition and expansion during the extrication from gas of a charge of such density; and, for the same reason, a large retort is directed. The ammonia rises immediately in the form of gas, and a portion of the water is, therefore, placed in a situation to condense it: in the subsequent stages, water will arise from the charge in the retort. The third vessel, directed in the formula, may be either a common bottle, fitting moderately (for no great pressure is necessary) to a straight tube issning from the bottom of the receiver, and dipping below the surface of the water it contains; or Woulfe's apparatus may be used; but, with moderate attention, the simpler means will answer better, perhaps, than the more complex. In either case, the receiving bottle must be kept cold by wet cloths, or ice; for the lower the temperature of the water, the greater quantity of ammonia gas it will condense, and the condensation is accompanied by an increase of its heat. If two bottles, each containing half the quantity of water directed, be used, they will be most manageable; as they may be changed alternately, so as to prevent either from being over-heated, and the contents of both may be mixed together at last. This preparation is colourless and transparent, with a strong peculiar smell. It parts with the ammonia in the form of gas, if heated to 130°, and requires to be kept, with a cautious exclusion of atmospherical air, with the carbonic acid of which it readily unites: on this latter account, the propriety of keeping it in small bottles instead of a large one, has been suggested. Water, saturated with ammonia gas, has a less specific gravity than common water.

THE GENERAL RECIPE BOOK.

To soften Iron.—Take half-an-ounce of tartar, two of common salt, and two and a half of verdigris. Mix all together, and expose it to the dew of nine nights running. This will turn into water, in which quench your iron when hot.

To soften all sorts of Metals.—Take sublimed mercury, euphorbium, borax, and sal-ammoniac, of each equal parts pulverised. Project some of that powder over any metal when in a state of fusion, and you will obtain the desired effect of making it soft.

To render Iron as white as Silver.—Take sal-ammoniac in powder, and mix it with an equal quantity of quicklime. Put them into cold water, and mix well. When done, any iron which you shall have made red-hot, will, if steeped in that prepared water, become as white as silver.

To solder Iron or any other Metal without Fire.—Take one ounce of sal-ammoniac and one of common salt, an equal quantity of calcined tartar, and as much of bell metal, with three ounces of antimony. Pound well all together, and sift it. Put this into a piece of linen, and enclose it well all round with fuller's earth about one inch thick. Let it dry; then put it between two crucibles over a slow fire, to get heat by degrees. Push on the fire till the lump becomes red-hot, and melted altogether; let the whole cool gradually, and pound it into powder. When you want to solder anything, put the two pieces you want to join on a table, approaching their extremities, as near as you can, to one another. Make a crust of fuller's earth, so that holding to each piece and passing under the joint, it should open over it on the top; then throw some of your powder between and over the joint. Have some borax, which put into hot spirits of wine till it is consumed, and with a feather rub your powder at the joint, you will see it immediately boil. As soon as the boiling stops, the consolidation is made; if there be any roughness, grind it off on a stone.

To solder Iron with Fire.—Make a paste with chalk and gum-water, which put round the two broken pieces placed on a table, and prepared as described in the preceding recipe. Rub over the two united extremities with melted soap; and after having thrown some of the above powder at the place of the joint, hold a piece of kindled charcoal over it. This will set the matter in fusion, which is no sooner done but you may take off the paste, and you will find it consolidated.

MISCELLANEA.

Railways in England.—The first public railway in England was begun in 1801, and was that insignificant horse-track from Croydon to Wandsworth. Others, of a similar description, gradually fol-

lowed; but only twenty Acts of Parliament for this purpose were passed in the first twenty years of the present century. In the next ten years (1820-30), forty-nine railway Bills were procured, and others are in contemplation. Mr. Whishaw, in his "Analysis of Railways," estimated them, in 1836 or 1837, at upwards of 840 miles, and those in contemplation would extend considerably beyond that distance when completed. The turnpike roads in England and Wales reach to upwards of 20,000 miles; the other public highways to 95,000; the navigable canals exceed 2200 miles in length; the rivers naturally navigable, or made so, 1800, giving a total water navigation of 4000 miles. If all these works had been constructed with the durability of the Roman roads and aqueducts (some few of them may have been), what a monument they would have remained of our national grandeur. Yet it may be questioned whether they will be allowed—whether any nation, vigorous enough to conquer us, however fallen, could become other than civilized with such an important element of civilization at hand. But as long as we do endure, what sources of wealth and stimuli to production, if the industry of the people had but fair field and no favour, no monopoly-protective taxes on the necessaries of life and the materials of manufacture. England at the present time possesses twenty-nine principal railroads, and 108 branches. Amongst these there are only thirty railroads of five to seven miles in length, the average length of the others being from thirty to forty miles. The Great Western is 140 miles long, and the Birmingham 130 miles. There are several other undertakings from seventy to ninety miles in length. It is calculated that, during the present year, the money received by the various railway companies in England for passenger traffic on their lines will amount to little less than £1,500,000. The total length of railways in England is estimated at 2336 miles, which cost on an average £12,000 per mile. The Manchester and Liverpool cost £27,000. In France there are at present sixteen railroads, the most important of which is that between Basle and Strasburg, and the Paris and Orleans line. The railway that cost the most for construction, is the line from Paris to St. Germain, which, in consequence of the value of the ground, &c., required an expenditure of 17,000*l.* per mile; and the one which conveys the most passengers, is that between Paris and Versailles, which has carried 40,000 persons in one day. In the United States there are 5000 miles of railway; the State of New York alone possessing 800 miles already completed; the principal line of which is that from New York to Erie, which is 350 miles long. In Germany, twenty miles of railway are completed; the most important line is that from Vienna to Beckma, which is 140 miles in length. There are also several other great lines constructing—viz. from Berlin to Hamburgh, Frankfort on the Order to Stettin, and from Magdeburg to Cologne. When these are completed, the Prussian and German Confederation will possess 3900 miles of railway. Austria is forming five principal lines—from Vienna to the frontier of Poland, to Lintz, Hungary, Trieste, Milan, and Venice. Russia is constructing railroads from St. Petersburg to Varsora, Odessa, and Moscow, and from Moscow to Varsora and Odessa. Belgium has six railroads; the principal line is from Ostend to Aix-la-Chapelle.

Conspiracy of Engine-tenters.—An engine-tenter, by the name of Demus Sharp, was brought up at the Bradford Court House, a short time since, charged by his employer, Mr. William Greenwood, with affixing a certain apparatus to the engine of his employer, whereby he destroyed, to a great extent, the power of the said engine, to the loss and detriment of his employer, and of all the hands employed in the factory. The prisoner has been in the employment of Mr. Greenwood for about two years, during which period he has been treated more as one of the family than otherwise; yet, during that period, he has repeatedly left his employer, for the purpose of obtaining an advance of wages. On every occasion of his leaving, it was found that no other engine-tenter, however much he might have been experienced in his business, could keep up so uniform a supply of power as the prisoner; and the consequence was, that he was reinstated in his situation, with an addition of wages and gratuities, till he attained to 32*s.* a-week, and eating and drinking whatever he required. On the morning of the 27th of April, he again left his employment, without giving notice; and Mr. Greenwood, naturally offended at such conduct, determined, if possible, to carry on without the prisoner's aid. He, therefore, set an experienced engine-tenter to work, and superintended. It was all to no purpose; the engine, one of thirty-horse power, could not be got up to more than from fifteen to twenty, and yet it was known to be capable of running from forty to fifty-

horse power. Mr. Greenwood, therefore, sent to the Bowling Company, who had made the engine, to send engineers to investigate the matter. They commenced their labours on Wednesday evening, and prosecuted their examination on Thursday and Friday, but without success. On Friday night, a mechanic of the name of Squire Baker, thought he could find out the cause of the effect, and he commenced an examination accordingly. At about one o'clock on Saturday morning, Baker found a tin tube, some fifteen inches in length, of the shape of a mail-coach guard's horn; at the small end, a piece of gas-piping was soldered in, and the end thereof had ascrew-thread for attaching it to other piping. In the centre of the tube was a check or valve, which, being open, admitted cold air from a cavity below the tube; but when the valve was shut, it excluded the cold air, and the engine was then capable of being worked to its full power. Enough was now discovered to explain the whole of the mystery, but the farther investigation of the subject was deferred till the mill ceased working on Saturday evening. The prisoner, however, was immediately taken from his bed and conveyed to the lock-up. During Saturday and Monday morning, farther light was thrown on the subject, and a man of the name of Birkby, an engine-tenter, at Batley, near Dewsbury, was taken into custody on Saturday forenoon, and became chief evidence against Sharp. It was also found that a tinner, of the name of Rawbottom, residing at Goldmansend, Bradford, had made the tube for, and under the direction of, Birkby, and that he delivered the same to him on Tuesday. There is also good and sufficient reason for believing that a confederacy, or trade's union, exists among the engine-tenters to a considerable extent, for the purpose of controlling the steam power, of commanding their own amount of wages, for insuring employment to their initiated brethren, and throwing out of employment all who would not join them in their nefarious proceedings.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, June 1, Quarterly General Meeting, At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, June 2, J. S. Buckingham, Esq., on the United States of America. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, June 2, J. S. Dalton, Esq., on Social Life in Ireland. At eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, May 30, G. Chitty, Esq., on Music. At a quarter-past eight o'clock.

QUERIES.

1. A receipt for a blue ink without gum, that will not discolour by the addition of any strong acid? 2. How to rectify oil of turpentine in a cheap and simple manner? 3. The best form of galvanic battery for experimental purposes?
Y. Z.

A description of a ginger-beer fountain, such as are used in the shops, with all the apparatus connected therewith? How to make a good bronze for bronzing brass-work? S. B.

The best plan of the slide-rests for a lathe, or in what book can I find it? Likewise where can I get them made the best, and what will be the expense of them? D. H.

["D. H." should read papers "On Cutting Screws in the Lathe," which have been in course of insertion in our Magazine. They are still to be continued.—Ed.]

1. How to make a twelve-inch globe of pasteboards; also, how to smooth its surface? 2. How to test silver? 3. How to cut the form of a medal upon boxwood in a lathe? E. L.

Having placed some mur. ammonia in a drawer with some copper coins, can any of your correspondents inform me why they turned blue; also what will remove the same; and also why a piece of steel which was in the same drawer, was not similarly affected? J. W. D.

The best test for the detection of arsenic? I would prefer Marsh's test. K. Y. L.

The greatest degree of expansion of the different gases, and the temperature at which this takes place. J. Jones, Jun.

What composition will fill a crack in boxwood engraving? Can any of your correspondents inform me where I can procure a seal-engraving machine cheap? Utile.

In the manufacture of sal ammoniac from the rough muriate (as made from gas liquor), at the close of the operation a considerable residue is turned out of the pots. Can any of your readers tell me what this residue is composed of? I find a considerable quantity of charcoal and much free acid. Would this residue be useful or not as a manure, or would the acid be injurious; and does it generally contain ammonia, or is the whole driven off before the close of the operation? I am desirous of making carbonate of magnesia from its sulphate. What are the best proportions of sulphate and of potash or soda, and what the best temperature to mix the solutions, and which poured into the other? E. Rowland.

I am obliged to "Mr. Hopkinson" for his directions for the electrical machine; but should be glad of a little farther information. 1. How must I fix the handle to the cylinder? 2. Is the hooping to answer the place of a spring, to which

the cushion is attached. 3. What is the use of the silk; and should the cushion be covered with it? 4. Where should the conductor be fixed; and must the ends be tinned and soldered on? 5. Where should the Leyden jar be fixed; what should it be coated with; and how must I charge it? Should I bring the chain up the side of the wire through the side; also, where should I place the discharging rod? J. SHEPPARD.

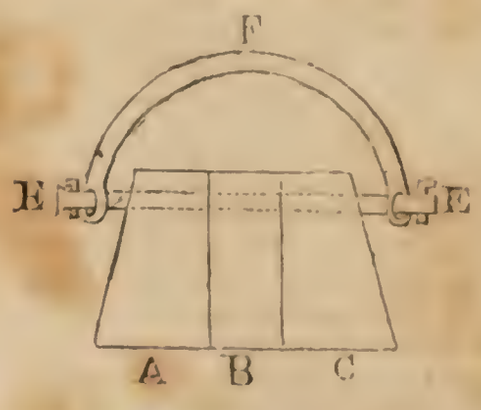
Which are the best kinds of metal pens, and their names? The manner of constructing a magic lantern? How is music performed on what are termed musical glasses, done by the touch of the finger? Is there acid of any description mixed with the water in those glasses, or is the water pure? J. J. L.

ANSWERS TO QUERIES.

To separate the Alcohol from Wines, &c., without the application of Heat.—The experiment that I allude to, is one devised by Mr. Brande; it may be performed as follows:—Into a certain quantity of wine or beer, placed in a convenient glass, add a solution of acetate of lead, until all the extractive colouring matter is precipitated. It must then be placed on a filter, and the liquid separated by filtration. The wine, by this means, is separated into the liquid and solid forms. The liquid consists of alcohol combined with water, and a portion of acetic acid from the acetate of lead. Dry carbonate of potash must now be added in sufficient quantity to combine with the water, which will depend, of course, on the quantity of water present; when sufficient has been added, the alcohol will rise to the top in a distinct stratum. Wine is best calculated to show this experiment; as it contains more alcohol than beer, and, consequently, requires less of the re-agents to produce the effect. A. TAYLOR.

"N. M." may dye his face a copper-colour, by going and residing about twenty years in the East or West Indies, or at the Cape of Good Hope. This recipe seldom fails.

"J. L. D." The three iron bars used by masons to raise weights, are called a lewis. The following is a description:—A B C are three pieces of



wrought iron, with holes in them, to admit the round iron bar, E E, which fastens by means of cotters, or wedges, to the bow, F. The hole in the stone is cut widest at the bottom; the pieces, A and C, are inserted first, and fixed close to the sides of the hole; the piece, B, is fixed between them; the bar, E E, thrust through the holes (the bow having first been placed as shown in the drawing) and the stone hoisted up. E. L.

Muriatic acid will take the stains from the fingers, caused by sulphate or oixde of zinc.

TO CORRESPONDENTS.

J. B.—*The following is one of the formulas for manufacturing oxalic acid:—Take of starch 1½ lb.; put it into a retort. Add to it 4½ lbs. of common nitric acid, and, when the action is over, add 1½ lb. of nitric acid. Heat, decant, and leave it to crystallize. Add fresh nitric acid to the mother-water, and crystallize again three or four times, until 10 lbs. or 12 lbs. of nitric acid have been used. The crystals are purified by solution in water and recrystallization. The nitrous gas which is disengaged, is used in the manufacture of oil of vitriol; so that it is seldom made on purpose. Another prescribed formula is the following:—Evaporate the fresh juice of sorrel almost to the consistence of honey, when it is to be poured into a glass vessel with a narrow neck, and covered with a stratum of olive oil. After some weeks, the sides of the bottle are covered with a crust, which is the salt of sorrel. The salt of sorrel is then to be dissolved in boiling water, and a small quantity of nitrate of barytes added to it, when the barytes will unite with the oxalic acid, and the potash with the nitric acid. The oxalate of barytes, which is precipitated, is then to be decompounded, by digestion with sulphuric acid, by which means the oxalic acid is let loose. None of the regular prescribed formulas for manufacturing this or any other chemical of large consumption, are now attended to; the manufacturing chemists conforming to their own processes, by which the articles are made at a much less cost, though not so pure, in many instances, as they ought to be.*

W. H. S.—*A brass rod will answer the purpose best: it should be at least eight feet long.*

T. L.—*Unprofitable controversy must be avoided. Besides, his letter is too personal, and we cannot, therefore, give it insertion.*

We cannot make any promise respecting the insertion of "C. G. M's" communication until we read it. We have very little doubt, however, from the general tenor of his letter, that we shall deem it acceptable to our readers.

K. S.—*Brandy will properly dissolve few of the essential oils, if any; it must be spirits of wine, at least sixty degrees over proof. Otto of roses is soluble only in pure alcohol.*

R. Hammond *will oblige by calling, as soon as possible, at our Office, No. 1, Long Lane.*

J. W. Dempster.—*We have not received the paper alluded to. Was he particular in addressing it as under?*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.
A MAGAZINE OF THE ARTS AND SCIENCES.

No. 85, THIRD SERIES. | SATURDAY, JUNE 4, 1842. | No. 333, OLD SERIES.

THE FACIAL ANGLE.

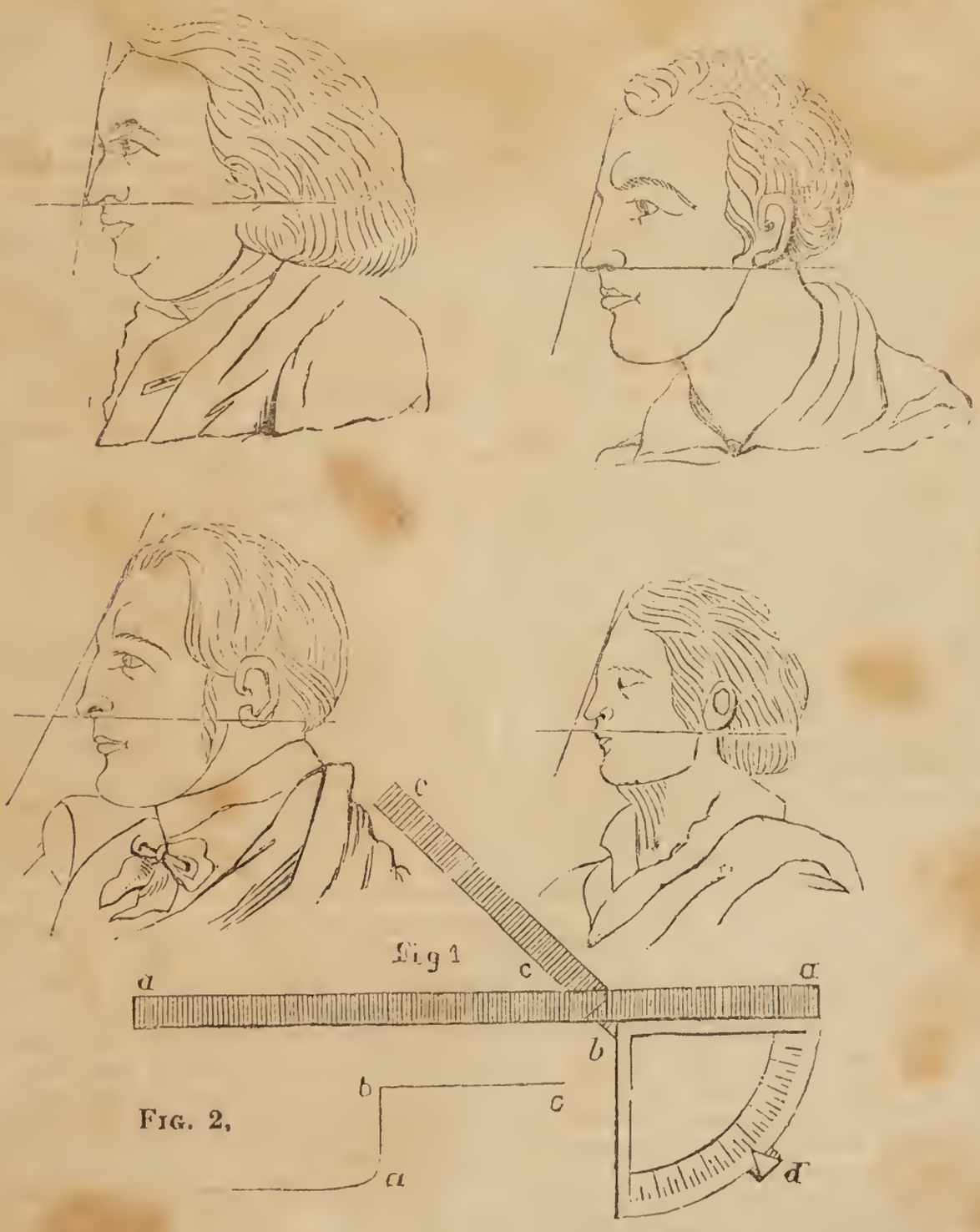


FIG. 2,

Vol. VIII.—No. 26.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

THE FACIAL ANGLE.

(See Engraving, front page.)

When phrenology is exciting an interest so very general, a short account of the facial angle of Camper may not prove uninteresting.

This theory receives, at present, considerable attention from the learned world; and, indeed, extensive and accurate observation seems to confirm it. A line is drawn from the lowest part of the external opening of the ear, to the middle point, where the ala or wing of the nostril, and the septum or division of it, meet.

This is called the horizontal line. A second line is drawn from the forehead, where it strikes the greatest surface, down, till it meets the horizontal line. This is called the vertical line. These two lines intersect each other at a little before the nose; and, of course, the angle which they form may be measured. This angle is the measure of the intellect, and the nearer it is to a right angle, the greater is the intellect of the person measured. If the angle measures more than 100°, it is deformity; and if it is below 60°, which very rarely happens, it is equally a deformity, and must be accompanied with great want of intellect.

The average of the European forehead is 80°; that of the Mongolian variety, the natives of Siberia and Greenland, from about 72° to 78°; the Ethiopian, including all the African nations, about 70°; the native Americans, 73½°, and the Malay variety, intermediate between the Negro and Asiatic, 75°. We may often amuse ourselves, by forming an estimate of the intellectual value of our friends, acquaintances, and those we meet in company, by the application of this rule; and it is surprising how quickly, and with how much accuracy, practice enables us to judge of the extent of the angle merely with our eye, making ideal lines on the countenance of the person we examine. Any one may soon do this, and thus compare together the talents of his several friends; or he may compare the watch-dog, of known sagacity, to the greyhound, which knows nothing but the chase. The figures in our front page, are heads of Newton, Lord Byron, Dr. Johnson, and John Kemble, with the angles formed upon them, to illustrate the theory of which we have attempted to give an account. In all these faces it will be seen, the angle is much above the ordinary average; and, should any persons want to see the antipodes of these, they have only to search their pockets for one of the old pennies of the reign of George III., and there, in the head of the good old King, they will find an angle far below the ordinary average, seemingly not above 50°. We wonder who the artist was that thus, with impunity, was allowed to libel and misrepresent majesty; he must have had a rather singular conception of beauty or dignity in the human countenance, who gave such a forehead to a human head. Had we been master of the Mint at the time, we never could have forgiven ourselves for allowing such a misrepresentation to go abroad into the world.

Description of the Engravings.

Fig. 1 is a faciometer, whereby those who wish to be more particular, may exactly measure the intellect of their friends. *a*, the upper part of the blade, to be applied to the under part of the external opening of the ear, and the lowest part of the division of the nose; *b*, a small curve, to adapt itself to the turn of the cheek-bone; *c*, the moveable blade, to be applied to the forehead; *d*, the point, showing the angle on the index of the quadrant.

Fig. 2, the profile of one of the blades, showing the curve at *b*, fig. 1; *a*, the greatest turn required; *b c*, the quadrant.

E. L.

ON CUTTING SCREWS IN THE LATHE.

No. VI.

32. It is extraordinary, and by no means creditable to the Committee of Mechanics appointed by the Society of Arts, to investigate and report on the merits of Mr. Walsh's invention, that they should have failed to discover the singular, and, as regards the originality of the design, most strange coincidence, obviously shown in it, to the daily practised mode of cutting screw-tools by pressure against a pattern screw, denominated a *hob*, while revolving in a lathe; the process is identical in all its details, and this renders the palpable ignorance or neglect of Mr. Gill and his brother committee-men less pardonable. Thus, it generally happens, that the funds of public bodies are grossly misapplied, the proposed object defeated, and genius coldly passed by, either because the officers, in whose judgment and ability the Society confide the solemn trust of an unbiassed adjudication, are incompetent or indolent: the taint of *mala fides* we do not impute to men otherwise conscientious and upright in all the relations of life. We do not accuse Mr. Walsh of *intentional*

plagiarism; doubtless he hit upon a plan which he considered advantageous, not being aware that the principle upon which he founded his claim to a public reward, had been similarly applied many years previously. The resemblance might be accidental, but it was the bounden duty of those gentlemen who acted and decided for the Society, to ascertain whether the invention was so far efficient and original, as to entitle its author to the pecuniary emolument or honorary distinction offered by the Society; for the printed conditions expressly require both efficiency and originality.*

33. A very ingenious method of converting a reciprocating rotary motion, of uniform or variable velocity, into an alternate movement in a given curve, so as to produce a spiral line on any cylindrical body, is developed in the lathe or turning engine,† invented by M. Grandjeau, of the Royal Academy of Sciences. By this machine, every variety of screw may be cut; it is a remarkable specimen of inventive genius, the principle by which the proposed object is attained being well known; but the application and arrangement of the parts are altogether novel.

Fig. 17.

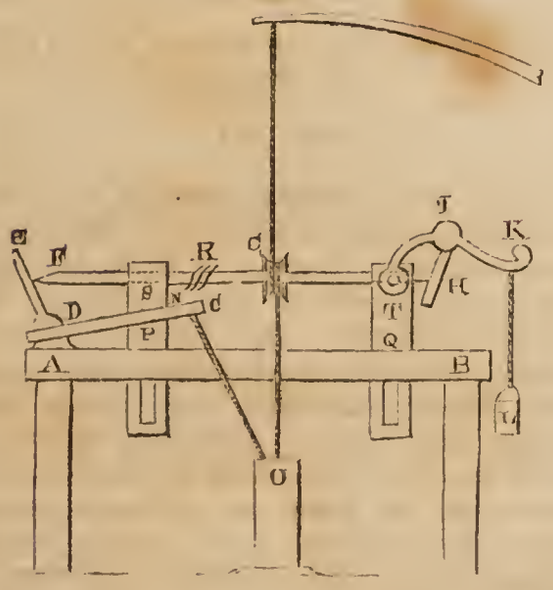
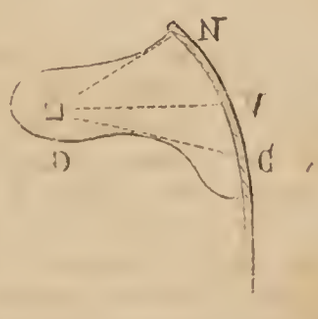


Fig. 17 shows the engine, composed of a firm supporting frame or bed, A B, and two head-stocks or puppets, P Z. Instead of fixed or moveable centre-points, these puppets have hollow circular collars, S T, which receive the mandrel, F H, whose extremities are accurately turned in a conical form; the mandrel carries the work, R, and also the pulley, G, which receives the cord, G O, attached to the treadle, O. The puppet, Q, carries an iron arm, I, to which is affixed at I, a square, H K, also of metal, one end of which presses on the point, H, of F H, and, consequently, tends to press it from H, towards F. The point, F, is supported upon a piece, E, which is moveable upon an axis, D; at the extremity of which, the piece, D C, is set upon a square; and in a groove cut in this piece, a sliding piece, N, moves, to which the band, N O, is attached, and thence passes to the treadle, O.

This preliminary explanation being understood, it will be evident that, when the foot is applied to the treadle, it will cause F H to revolve, and will also lower the piece, D C; consequently, this motion of D C, will cause F H to advance from F towards H, in a quantity which will be always reciprocally proportional to the distances, D N, of the sliding-piece, N, from the centre of motion, D; and the piece, N, being moveable, it may be adjusted or placed in any required situation: hence it will result that, during a revolution, the axes will advance whatever distance may be required, and, in like manner, a cutting tool, applied at R, will trace the spiral thread of a screw. If a spiral or screw be required, the thread of which shall become gradually closer or finer, it will be necessary to take off the piece, D C, and substitute, in its place, the piece D N C, fig. 18, the periphery, N V C, of which is a curve, in which the radii, D N,

Fig. 18.



D V, D C, increase, as the thread of the screw to be cut is required to close. Thus, each point of the curve, as C V N, will successively perform the office of an arm or lever of different length, continually substituted for D N, which will necessarily

* It was my intention to have introduced, in this place, a description of the tools usually applied for cutting screws in a lathe; as also to have afforded the best information within my reach, of the best mode of making them, which, simple as it may appear to the uninitiated, is a matter of considerable difficulty. Circumstances, however, have induced me to defer this part of our inquiry, until I shall have concluded the history of the lathe as a screw-cutting engine, when I hope to be enabled to present the readers of the Penny Mechanic with full and satisfactory details on the subject.

† *Machines approuvees par l'Academie*, vol. v., 1729, No. 336.

produce an unequal retrograde motion of F H towards H; and hence the spiral or thread of the screw will be graduated, as the radii, D C, D V, D N.* A. M.

HISTORY OF MEDALS.

THE study of medals is not of very ancient date: none of the classic writers give any account of collections of them; though, indeed, many little particulars are passed without notice by them. In the times of the Greeks, a collection of such coins as then existed, must have been but little regarded, as consisting only of those struck by the numerous little states which at that time used the Greek characters and language. Hence they would have had an air of domestic coinage, and no attention would have been paid to them, however exquisite their workmanship might have been. The little intercourse at that time carried on betwixt the different provinces, also greatly impeded any communication of knowledge to those who wrote histories; so that it is no wonder to find any small collections that might then have existed, altogether unnoticed by them.

Almost as soon as any communication was opened between the Greeks and Romans, the latter treated the arts of the Greeks with all due respect and applause. Their coins were imitated by the Romans, and preserved in cabinets, by the senators, among their choicest treasures. Suetonius informs us, that, on solemn occasions, Augustus was accustomed to present his friends with medals of foreign states and princes, along with other valuable testimonies of his friendship. In a more advanced period of the Roman empire, however, individuals would undoubtedly form collections of coins peculiar to their own state; for Dr. Stukely, in his "Medallic History of Carausius," informs us, that a complete series of silver coins was lately found in Britain, containing all the emperors down to Carausius, inclusively. From Banduri we also know, that certain Greek coins were specially preserved by the Romans; and it appears from their code, that ancient gold and silver coins were made use of instead of gems; to which distinction, those of Sicily were particularly entitled. From the decline of the Roman empire till towards the end of the fifth century, almost all branches of literature were involved in darkness, and the medallic science among the rest. While the Christian dominion of Constantinople lasted, indeed, almost all the arts and sciences may be said to have been kept within its own boundaries; though the Arabs and eastern nations had some arts and sciences of their own: but, after the destruction of the imperial city by the Turks, the Greeks were once more compelled to become fathers to the European science. Even before this time, indeed, some vestiges of a revival of literature had appeared in Italy; "and so intimate and necessary a connexion," says Mr. Pinkerton, "has now the study of medals with that of ancient erudition, that, on the earliest appearance of a revival of the latter, the former was also disclosed."

The first among the moderns who began to study the medallic science, was Petrarch. Being desired by the Emperor Charles IV., to compose a book containing the lives of eminent men, and to place him in the list, he replied, that he would do so whenever the Emperor's life and conduct deserved it. In consequence of this conversation, he afterwards sent the Emperor a collection of gold and silver coins, bearing the representations of eminent men, with an address suitable to his former declaration. A collection of coins was made in the next age by Alphonso, King of Arragon; but though this monarch collected all that could be found throughout Italy, we know that there could not have been very many, as the whole were contained in an ivory cabinet, and carried always about with him. A very considerable collection was made by Anthony Cardinal St. Mark, nephew to Eugene IV., who ascended the pontifical chair in 1431; and, soon after, the grand museum at Florence was begun by Cosmo de Medici, where a collection of ancient coins and medals had a place among other curiosities. Corvinus, King of Hungary, about the same time, formed a noble collection of coins, along with ancient manu-

* My attention has just been directed to a contemporary journal, designated "The Magazine of Science and School of Arts." In No. 164, May 21st, of this work, I find this identical machine of M. Grandjean copied on an enlarged scale, and with some few unimportant additions, but without the slightest intimation of the original source from whence the information was obtained. To this article, which is headed "Turning the Elizabethian Twist," the name of "James Wilcox" is subjoined. Now the machine is applicable to every variety of screw; and "Mr. Wilcox" would not have lowered himself in the opinion of men of science, had he avowed, at once, that the merit of the arrangement—for invention it cannot be called—was due to M. Grandjean, and not to himself, as his paper would induce the reader to imagine.

scripts and other valuable relics of antiquity.

Mr. Pinkerton considers Agnolo Poliziano—more commonly known by the name of Angelus Politianus—as the first writer who adduced medals as vouchers of ancient orthography and customs. He cites different coins of the Medicean collection in his "Miscellanea," written about the year 1490. By means of a cabinet of medals, collected by Maximilian I., Emperor of Germany, Joannes Huttichins was enabled to publish a book of the lives of the emperors, enriched with their portraits, delineated from ancient coins. It is generally supposed that this book, which appeared in 1525, was the first work of the kind; but Labbé, in his "Bibliotheca Nummaria," mentions another, named "Illustrium Imagines," by one Andreas Fulvius, printed in 1517, in which most of the portraits seem to be from medals. About the year 1512 also, Guillaume Bude, a French author, had written his treatise "De Asse," though it was not printed till many years afterwards. M. Grollier, treasurer of the French armies in Italy, during part of the sixteenth century, had a great collection of coins of different kinds of metals. After his death, his brass medals were sent to Provence, and were about to be sent into Italy; when the King of France, having got information of the transaction, gave orders to stop them, and purchase the whole at a very high price, for his own cabinet of antiquities. M. Grollier had an assortment of gold and silver as well as of brass medals: the cabinet in which they were contained, fell, two centuries afterwards, into the hands of M. l'Abbe de Bothelin; and was known to have been that of Grollier from some slips of paper, on which was his usual inscription for his books, Joannis Grollierii, et amicorum.

ON THE CHEMICAL PRINCIPLES INVOLVED IN VEGETATION, AND THE AGENCY OF MANURES.

By R. H. Brett, Ph. D., F.L.S., &c.

The phosphate of lime found so abundantly in many plants, may be derived from mineral waters and from the soil; but as this salt is insoluble in mere water, it may be asked, in what way can it be taken up by the roots of plants? It has been clearly proved by experiment, that water containing carbonic acid, is capable of dissolving phosphate of lime. "A very simple experiment is sufficient to make this evident:—To a small crystal of muriate of lime, dissolved in a little rain water, add another small portion of phosphate of soda, also in solution in rain water, a white gelatinous-looking substance will be obtained; this is phosphate of lime. Put this into a bottle of common soda water, cork it, and occasionally agitate it; after a short time, the whole or greater part of the phosphate of lime will be dissolved by the water, charged, as it is, with carbonic acid gas." Now the phosphate of lime found in mineral waters, is held in solution by carbonic acid gas, but in very small quantities: from this circumstance, it has escaped the notice of most persons who have analyzed mineral waters. Berzelius, however, detected it some years ago in waters of Carlsbad, in the proportion of about fifteen grains to ten pounds of the water. But it has been before stated, that almost, if not all soils, contain phosphate of lime, and, from the known agency of carbonated water upon this compound, we can have no difficulty in accounting for the mode in which it may be brought into solution, so as to be taken up by the roots of plants. During the decay of vegetable substances, as before stated, carbonic acid gas is formed; this will be partly retained by the moisture of the soil, and partly discharged into the atmosphere, and that portion dissolved in the moisture of the soil, would naturally act upon the phosphate of lime present, and effect its solution; but besides carbonated water, certain ammoniacal salts appear to effect the solution of phosphate of lime in water, especially muriate of ammonia or sal ammoniac, to which, in all probability, may be added common salt. With respect to the first of these compounds, in its action upon phosphate of lime, it will come under notice when considering manures, especially *guano*, which usually contains a good deal of sal ammoniac. Phosphate of lime occurs in larger quantity than the phosphate of magnesia in plants, and the one is more extensively diffused throughout the mineral kingdom than the other; this substance is, nevertheless, present in the seeds of all the grass tribes. As fifteen parts of water will dissolve one part of this salt, we may readily understand how it can be taken up by the roots of plants. Carbonated waters would also dissolve phosphate of magnesia. Phosphate of magnesia has a great tendency to combine with ammonia, and form a salt possessing very little solubility in water. When present, therefore, in animal or other manures rich in ammonia, it would, doubtless, combine

with a portion of the ammonia present; and it is highly probable that this compound of phosphoric acid, magnesia, and ammonia, is really present in those plants which are found to yield phosphate of magnesia from their ashes; for, when the plant was burnt, the ammonia, previously combined with the phosphate of magnesia, would be volatilized with the other gaseous products. Nor could it be fairly urged against the opinion, that this ammoniacal salt exists as such in certain plants, that the salt is nearly insoluble in water; for it is, like phosphate of lime, capable of being dissolved in carbonated waters, and, in that manner, could be taken up by the roots of plants. Sulphate of lime or gypsum, is a salt found less abundantly in plants than phosphate of lime. The leguminous plants appear to contain gypsum as an essential ingredient; and this calcareous salt, occurring abundantly as a mineral production, and being soluble, to a certain extent, in water, is capable of being thus taken up and appropriated to the special use of certain of the vegetable tribes. But gypsum or sulphate of lime, according to Liebig, performs another important part, from the circumstance of its being able to fix ammonia, so as to prevent the loss of the latter substance by volatilization. The exact mode in which this substance acts, will best come under notice, when treating generally of manures. The earth, alumina, which, with silex, forms the basis of all clays, is said to form one of the inorganic ingredients of plants. It occurs in great abundance in the mineral kingdom, chiefly, although not exclusively, in combination with silex. Alumina, although insoluble in mere water, is soluble in alkaline fluids, and is readily dissolved by sulphuric acid; and it is most probable that, in one or other, or both of these ways, it is brought into a state capable of being taken up by plants. Silex or silica, which enters largely into the inorganic part of the straw of wheat, oats, &c., is one of the most abundant of mineral substances. It is found in great quantity in all the primary rocks; it occurs in secondary and tertiary, or stratified rocks, and is never absent in the various subdivisions of these latter. Thus, in the marls and clays belonging to the tertiary strata, silex abounds. In the cretaceous formations of the secondary strata, it is also met with; sometimes in the form of flints, at others in the form of green sand, sand stone, and marl. Silex, in its pure uncombined state, does not dissolve in water; it requires, for that purpose, to be united to an alkali, such as potass or soda; now, as the granitic rocks contain potass or soda, such rocks, by their disintegration, are highly calculated to afford both silica and potass, in a fit state to be dissolved by water, and taken up by the roots of plants. It is well known that many mineral waters contain silica, in all probability rendered soluble by an alkali. The silicification of wood is most likely referrible to the action of waters containing siliceous matter in solution. The silex, however, which abounds in the stems of plants belonging to the grass tribe, is not in combination with an alkali, although it might have been in such a state of combination previously to its having been absorbed by the roots of the plants; in fact, the quantity of potass and soda contained in the ashes of the straw of wheat, rye, barley, and oats, is too small, compared with the quantity of silex, to render the latter soluble. Thus, in the straw of wheat, the relative proportions of silex and potass are as 143½ of the former to 1 of the latter, and not much difference has been found in respect to the relative quantities of silex and soda; the latter, however, according to Sprengel, is rather more than the potass. In the straw of rye, the relative proportions of silex and potass are said to be about 76 of the former to 1 of the latter; the relative proportion of silex and soda being about 229 of the former to 1 of the latter. In barley, on the contrary, in the straw, the relative proportions of silex and potass are as 38½ to 1½ nearly; the soda, in this case, being only about one-quarter the quantity of potass. The straw of oats is said to contain silex and potass in the proportion of about 5½ of the former to 1 of the latter. It is known that, under ordinary circumstances, in order to render silex soluble in water, it must be combined with about four times its weight of potass; it is obvious, therefore, that the potass and soda, taken together in any of the above instances, are totally insufficient to render the silex soluble. Assuming, therefore, that the silex was originally rendered soluble by its union with potass, and, in this state, taken up by the roots, and again deposited in a crystalline state in the stems, it is clear that by far the greater part, if not all, the potass, must have been again restored to the soil; probably for the purpose of combining with more silex, which, being thus rendered soluble, is taken up and again appropriated by the plant; the potass again being restored altogether, or in part, to the soil, for the purpose of continuing its function of transporter of silex from the soil to the plant.

It is probable, however, that this is not the only way by which silica is supplied to plants. Berzelius has shown, that this substance, under certain conditions, is really soluble in water, without being combined with any alkali. In some mineral waters, silica, not combined with an alkali, has been found. Klaproth obtained nine grains of silica from somewhat less than three pints of water; in this case the water, however, was alkaline. It has, moreover, been observed, that silica, under certain conditions, readily dissolves in water containing an alkaline carbonate, and that, too, without any decomposition of the latter. It is very probable, that it is under similar circumstances that the silica is dissolved in water, after the disintegration of those rocks which contain this substance, together with alkalies and alkaline earths. For example, when a granite rock, containing felspar and mica, is decomposed by the joint influence of air and moisture, the potass becomes converted into carbonate of potass; and some of the silica, thus liberated, dissolves in the water, which also contains carbonate of potass in solution. From the foregoing facts, we appear to be justified in assuming, that plants may obtain silex in three ways:—First, from silica chemically combined with potass; secondly, from silica simply dissolved in water; thirdly, from silica dissolved in water containing an alkaline carbonate. Before concluding the consideration of the inorganic constituents of plants, it may be well to make a few remarks upon a fact which is likely to lead hereafter to very important practical results. Saussure noticed, that the same description of plant contained very different proportions of inorganic matter at different periods of their growth. Wheat, for example, a few weeks before flowering, containing nearly eight per cent. of inorganic materials, contained, when in flower, only five and a half per cent., and, when arrived at maturity, only three and a third per cent. It has also been observed, that the potatoe leaf contains less alkali as the plant advances towards maturity. A multiplication of such facts as these, it must be confessed, would be highly important. Experiments should be made, not only for the purpose of ascertaining the relative proportions of inorganic matter, taken as a whole, at different periods of vegetable growth, but also the relations in quantity, which the various inorganic ingredients, making up the ashes of plants, bear to each other at different stages of growth.

CONSTRUCTION OF SLIDE-REST

To the Editor of the Penny Mechanic and Chemist.

Sir,—I beg to inform "D. H.," through the medium of your Journal, that I am not aware of any work in English, that contains such a description of a slide-rest as would enable him to construct one, at least, without the assistance of a skilful and practised mechanic.

The French scientific journals afford much useful information respecting the slide-rest, and the plates are almost uniformly drawn to a scale—a practice we should do well to follow; but I doubt whether "D. H." could procure many of these scattered *feuilletons*, even were I to give him a list.

The cost of a slide-rest depends on the size, and this—I mean the length of the main slide—is, absurdly enough, governed by the height of the centre from the bed or bar; thereby assuming, that nothing of greater length than *one-half* of the largest surface the lathe is capable of turning, is required to be worked. Now there are *three* descriptions of slide-rests—1st, the parallel; 2ndly, the compound; 3rdly, the circular. One suitable for a six-inch centre lathe, combining all the latest improvements, would cost at least *twenty pounds;* and even after this outlay, "D. H." would find he possessed an apparatus of but limited power.

Messrs. Holtzapfell's catalogue gives the annexed scale for "sliding rests for metal turning, of cast iron, made very strong. They turn work of the following dimensions:—

"Those for .... 3½, 4, 5, 6, 7-inch lathes,
Turn surfaces of 7, 8, 10, 12, 14 inches diam.
And cylinders .. 5, 6, 8, 10, 12 inches long,
£10, 12, 15, 18, 21."

It must be remembered, however, by "D. H.," that the rests here mentioned, are made of the cheapest materials, principally cast iron, instead of steel and gun-metal, as they should be, and are of the most simple construction; consequently, he may form some notion of the cost of a superior article, from the *atelier* of these extravagant machinists; to visit which, a man's purse need be longer than his head! Should "D. H." wish it, I can give him the address of a very ingenious lathe and tool-maker, whose work is quite equal to that of Messrs. H., and his charges infinitely more moderate.

So much depends on the slide-rest, not only in ornamental turning, but also in producing a plane surface on metal—on the truth of which, the value of many

machines, either wholly or in part, is entirely dependent—that I am disposed to think, a series of papers on this subject would be acceptable to the readers of the PENNY MECHANIC. Feeling this very strongly, and having encountered many difficulties myself, for the want of plain instructions, I propose to commence such a series so soon as I shall have concluded those now in hand on another equally important branch—"Cutting Screws in the Lathe."

I remain yours, &c.,
AN AMATEUR MECHANIC.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, June 8, N. J. Larkin, Esq., on Crystallography. Friday, June 10, J. H. Pepper, Esq., on the Mechanical and Chemical Properties of Metals, and the Influence that Light, Heat, and Electricity, exert upon them. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, June 9, H. Buss, Esq., on Music, as an Imitative Art. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, June 9, Joseph Bateman, Esq., LL.D., on the Natural History of Man. At eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, June 6, Discussion—Is there a Material World? At a quarter-past eight o'clock.

QUERIES.

What is the method of casting brass; also the analysis of the whitish floury substance so common on old brick walls; and the cheapest and easiest way of making chlorine? W. B. W.

I observe in your PENNY MECHANIC for 30th April, page 159, a new process for manufacturing bricks, &c.; wherein it is stated the clay is dried and ground to powder, and put into metallic moulds. Can you or any of your correspondents give a description of these moulds, and state how the hydraulic press can be worked so fast as stated in that communication? J. S.

The simplest way of making a hole through common window-glass? Also, the method of plating small brass ornaments, so as to resemble silver? MECHANIC.

How to make a belt to support the body in swimming; what weight of cork would it be necessary to put in the belt, to sustain a person weighing 150 lbs.? F. STEWART.

Do the cutlers of Sheffield make use of any composition to preserve their bright steel from rust? Is there any composition that will prevent the oxidation of iron, which is subject to a strong heat—as the flue from a stove, for instance, exposed to the weather? Paint, &c., peels off.
W. C. J.

As glass-blowing has been so very instructively noticed, of late, in your invaluable Magazine, I think it is not unlikely but some one of your intelligent readers may like to avail himself of an apparatus for that purpose; if so, such a one may suit himself, at almost a nominal cost, by applying at 10, Great James Street, Hoxton Old Town, Shoreditch.

I shall be obliged to "G. S., Jun.," if he will describe middle C of the open and stopt flute (wood), so that I may construct the proper scale; and are not the open pipes nicked on the cap, instead of on the block? TYRO.

ANSWERS TO QUERIES.

Perhaps "E. L." will state more accurately what he means by the query, "How to cut the *form* of a medal upon box-wood in a lathe?" If he wish to obtain a fac-simile of the medal by the aid of a lathe, I may be enabled to assist him; but the apparatus is rather costly.

"Utile." There is an excellent description, with engravings, of a very superior seal-engraving lathe, in Gill's "Technological Repository."
AMATEUR MECHANIC.

"A. M." receives the thanks of "G. Starkey," for his kindness in publishing, through the medium of the PENNY MECHANIC, his papers on "Screw Cutting in the Lathe," from which he has derived considerable information. "G. S." likewise begs to inform "A. M." that he has endeavoured to obtain the work he mentioned in the PENNY MECHANIC, but has not yet been successful; but should feel greatly obliged to him if he would, as he promised, forward the requisite information on cutting that particular kind of twist, as found upon old furniture, which has been designated the Elizabethian twist.

TO CORRESPONDENTS.

J. R., Oxford.—*We shall be glad to receive his communication, and have little doubt it will find its way into the pages of our Magazine.*

James Smith *can procure the articles from any druggist.*

Daniel Constable.—*The two pumps can be worked from the same well, though one be 150 feet from it, provided the supply of water be sufficient.*

W. Courtney, Pimlico, *will see that we have inserted his query afresh. His communications will, we dare say, be acceptable.*

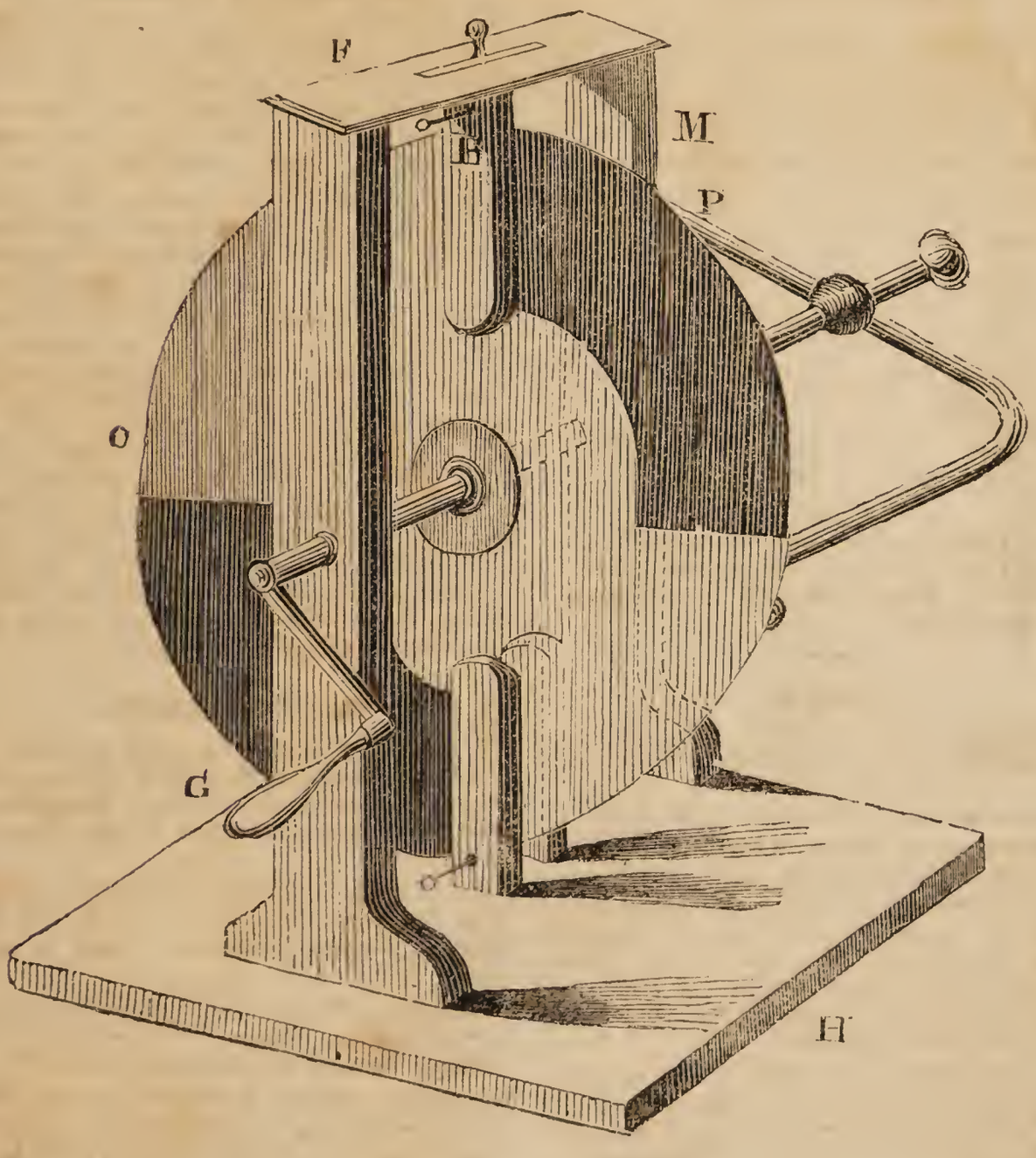
We must beg to decline S. Clark's *communication in its present form; it would not be sufficiently interesting to our readers, unless it could be arranged so as to form part of a series.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.
A MAGAZINE OF THE ARTS AND SCIENCES.

No. 86, THIRD SERIES. | SATURDAY, JUNE 11, 1842. | No. 334, OLD SERIES.

THE PLATE ELECTRICAL MACHINE.



Vol. VIII.—No. 27.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

THE PLATE ELECTRICAL MACHINE.

(See Engraving, front page.)

When glass was first used as the electric of a machine, the form of a globe was adopted; but afterwards, the cylinder was found more convenient and economical, and entirely superseded the globe. Dr. Ingenhouz, however, introduced the use of a flat cylindrical plate, turning on a horizontal axis in the manner of a wheel; and the machine, thus constructed, has many good properties; it is simple, elegant, compact, and powerful. A representation of it is given at fig. 1. On a stout board, G H, are firmly jointed two uprights, L M, which are united, for the purpose of greater steadiness, by the cross piece, F. The plate, O P, is ground truly flat, and a hole is made in its centre, by which means it can be fitted upon an axis, the form of which is shown at fig. 2. The

Fig. 2.

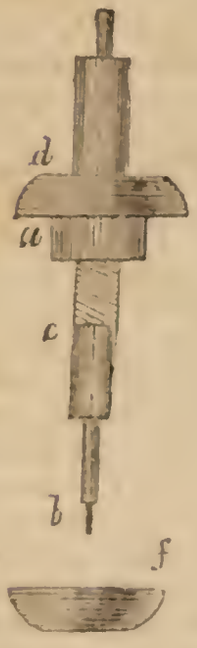
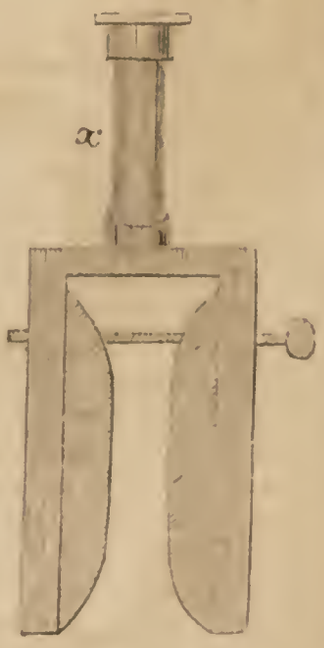


Fig. 3.



part, *a*, of this axis, is thicker than any other part of the side or half, *a b*; at *c*, the axis is screwed, and this screwed part is rather less in diameter than the part, *a*; but by the depth of the thread, at least, it is more than the thickness of the part, *c b*. The hole in the centre of the plate just fits the part, *d*; another shoulder, *f*, being tapped, so as to screw upon *c*, will, therefore, when screwed on, make the plate as tight as may be necessary, because the screw reaches a little within the perforation of the glass. The direction in which the plate is revolved, should be contrary to that which would open the screw.

Plate machines have, at least, four rubbers—two on each side of the glass. These rubbers are made of red leather, stuffed with curled hair, like those of the common machine; but they are connected together in pairs, and made to press against the glass by screws, one of which is shown at *h*, fig. 1. To these rubbers are attached flaps of black oiled silk, *k k*, on one side of the glass.

The rubbers, used in the state which has been described, will produce only an insignificant excitation of the plate; in order, therefore, to increase its effects, it is rubbed with a mixture of metals, called an amalgam. For the amalgam of zinc, heat four or five parts of mercury higher than the boiling-point of water, and have in readiness one part of melted zinc. Pour the heated mercury into a wooden box, and, immediately after, pour the melted zinc upon it. Close the box, and shake it for about half-a-minute. After the amalgam, thus made, is cold, mix it, by trituration, with a small quantity of grease—such as tallow, mutton suet, &c.; a very small quantity of finely-powdered whitening may be added.

Before the amalgam is applied, the plate and flap should be freed from all kinds of dirt and dust; a leather, covered with tallow, may then be held against the plate while it is turned. When the glass is entirely obscured, lay the greased leather aside, but continue to turn the plate till the flap has taken off part of the grease; then if a small quantity of the amalgam, spread upon another piece of leather, be held against the side of the plate while it is revolved, the excitation will soon become very strong, and sparks may be obtained from the conductor in abundance. The insulation of the rubbers, and, consequently, the obtaining of negative electricity, is not so easily performed by the plate machine as the cylinder one: the means yet adopted to accomplish this, have, in general, been rather complex. It may, however, be done by making the rubbers in the form shown at fig. 3; the part, *x*, being glass, and cemented by a cap, at the top and bottom, to the rubber and the frame; chains or wires must be used, when the rubbers are intended to communicate with the earth for the supply of positive electricity.

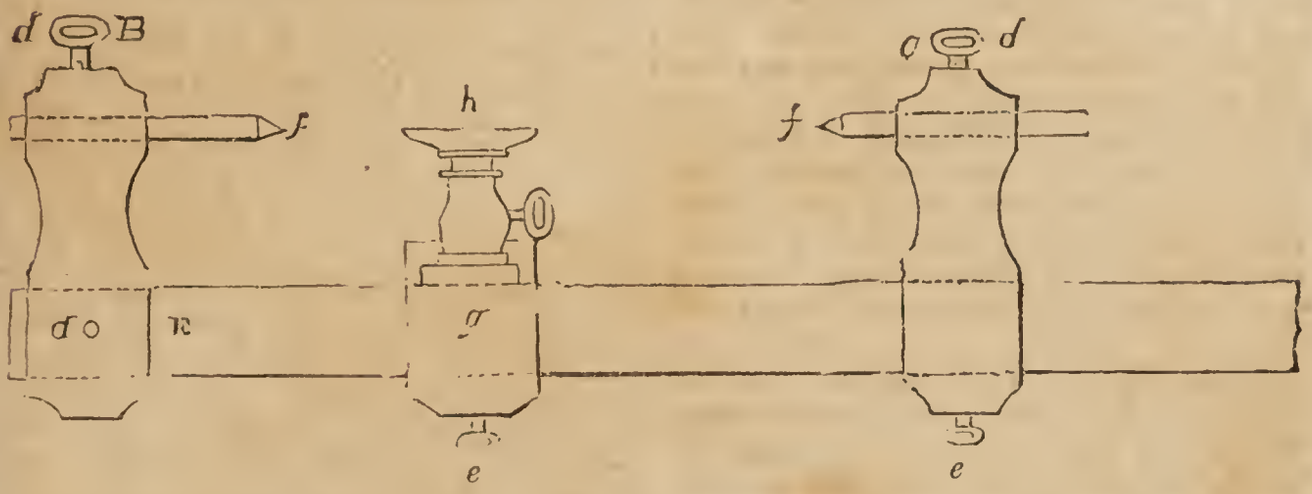
From the great surface exposed by a plate, these machines are susceptible of a strong excitation, and they have, of late, been preferred by lecturers in general; they would, probably, be still more common, were it not for the great expense of ground glass, when of large diameter.

A much cheaper machine than the above may be made, by using, instead of the plate, a thin piece of dry board, turned in the same form, and varnished with a solu-

tion of sealing-wax and alcohol; it answers exceedingly well. The sealing-wax must be put into alcohol in small pieces, and, when dissolved, the board must be covered with it by means of a camel's-hair pencil. Several coats will be necessary.

E. L.

THE CLOCKMAKER'S THROW OR TURNING BENCH.



To the Editor of the Penny Mechanic and Chemist.

Sir,—The clockmaker's turning bench is generally made of a bar of iron or steel, with iron or brass heads sliding on it. A is a rectangular bar, filed or planed perfectly straight and true. On this bar two heads are fitted, B C; B is made a fixture on one end of the bar by means of a pin, *d*; while C is made to slide up and down the bar, and tighten in any part by means of the binding screw, *b*, equally distant from the bar, and parallel to it; two cylindrical holes are made, into which are fitted two steel cylinders, *f f*, having male centres at one end, and female centres at the other. Both ends of these cylinders or centres, as they are called, are hardened; they are made to fit, yet slide easily through the heads, and tightened by means of the binding screws, *d d*. On the top, between the two heads, a third piece is made to slide along, G, having an oblong hole at right angles with the bar, into which a rest is fitted, *h*; this rest is fitted with a T and binding screw, similar to a common rest, and is fastened down to the bar by means of the binding screw underneath, *e*.

This lathe is generally held in the vice, and the work, having a small pulley fastened on it, is placed between the centres; a bow, generally the drill-bow (a piece of cane and catgut), is passed round the pulley, as in drilling, and worked up and down with the left hand, while the right is used to turn with. The greatest disadvantage attending this plan is, that the work moves backwards and forwards, similarly to the pole-lathe. The up-stroke is entirely lost; the bow is generally put on for the work to revolve the right way in the down-stroke. To give it a regular rotary motion, I alter my principle, and make a hand-lathe of it, by fixing a bracket on the bar at *e*, which stands at right angles with it, and carries a wheel, a description of which I will give, under "hand-lathe," in my next; and on the centre, *c*, of No. 1 head, I fit a socket, having a circular plate on it, in which I fix a piece of wire or screw to carry round the driver. Turning benches are made all sizes; some of them are made in Geneva. I have seen them small enough to go into the waistcoat pocket, or large enough to take in three or four inches. There are, likewise, various forms and shapes; but as I have nothing to draw from, or refer to, in the drawings I shall send, I will endeavour simply to lay down the plan, and give as useful a shape as I can think of for a working man, leaving your numerous readers to beautify and amend them as they please.

I remain yours, &c.,

Fabier.

HISTORY OF MEDALS.

(Continued from page 205.)

Contemporary with Grollier was Guillaume de Choul, who was likewise a man of rank and fortune. He had a good collection of medals, and published many in his "Treatise on the Religion of the Ancient Romans," in 1557. In the Low Countries, we know, from the letters of Erasmus, that the study of medals was begun about the beginning of the six-

teenth century. About the middle of that century, Hubertzus Goltzius, a printer and engraver, travelled over most countries in Europe, searching for coins and medals, in order to publish books concerning them. From one of these works it appears, that there were then in the Low Countries, 200 cabinets of medals; 175 in Germany; upwards of 380 in Italy, and 200 in France. It is probable, however, that there are now four times as many in these countries, besides 500 in Britain; but we are not to imagine that all these were grand collections, for of such there are not above a dozen even in Italy; most of those just mentioned, were of the class named caskets of medals, containing from 100 to 1000 or 2000.

There are few countries, Italy excepted, in which a greater number of coins have been found, than in Britain; though we are by no means well acquainted with the time when the study of them commenced. Mr. Pinkerton suspects that Camden was one of the first, if not the very first, British author who produced medals in his works, and who must have had a small collection. "Speed's Chronicle," published in the seventeenth century, was illustrated with coins from Sir Robert Cotton's cabinet. Gorlæus's collection was purchased by Henry, Prince of Wales, brother to Charles I., to whom he left it at his death. According to Joseph Scaliger, it consisted of 30,000 coins and medals. A collection of 5500 coins was purchased by Archbishop Laud for 600*l*., and given to the Bodleian Library. Thomas, Earl of Arundel, Earl-marshal of England, well known from the Arundelian tables and other antiquities which he imported from Greece and Italy into Great Britain, had a rich cabinet of medals collected by Daniel Nisum. The Dukes of Buckingham and Hamilton, Sir William Paston, Sir Thomas Fanshaw, of Ware Park, Sir Thomas Hanmer, Ralph Sheldon, Esq., Mr. Selden, &c., are enumerated by Evelyn as collectors of medals. Charles I., as well as his historian, the Earl of Clarendon, were also collectors. The king had a very fine cabinet; which, however, was dissipated and lost during the civil commotions. Oliver Cromwell had a small collection; and the cabinet of Charles II. is mentioned by Vaillant in the preface to his treatise, entitled "Nummi in Coloniis," &c. This branch of magnificence has not been much attended to by succeeding British monarchs; though Geo. IV. had a very good collection of ancient gold coins.

A great number of fine cabinets have been formed in Britain since the time of Evelyn. About the year 1720, Haym makes mention of those of the Duke of Devonshire, the Earls of Pembroke and Winchelsea, Sir Hans Sloane, Sir Andrew Fontaine, Mr. Sadler, Mr. Abdy, Mr. Wren, Mr. Chicheley, and Mr. Kemp. At present there are many remarkable collections; but that of the late Dr. William Hunter is deservedly esteemed the most remarkable in Europe, excepting that of the late French king. It was not only formed at a great expense, but with much care and ability; many foreign medals offered to it having been rejected. This collection, as well as the rest of Dr. Hunter's Museum, is now in the possession of the University of Glasgow, to which it was bequeathed by the Doctor's will. The other remarkable collections are those of the Duke of Devonshire, the Earl of Pembroke, Earl Fitzwilliam, formerly the Marquis of Rockingham's, the Honourable Horace Walpole, the Rev. Mr. Crachrode, the Rev. Mr. Southgate, Mr. Townley, Mr. R. P. Knight, Mr. Edward Knight, Mr. Tyson, Mr. Barker, Brown, and several others. The British Museum and universities in England, have also collections; as well as the Advocates' Library, the Antiquarian Society, and the universities in Scotland.

ELECTRICAL APPARATUS.

To the Editor of the Penny Mechanic and Chemist.

SIR,—In answer to "J. Sheppard's" query concerning the electrical apparatus, I send the following, if you deem it fit for insertion:—To the cylinder there should be cemented two brass caps, so as to fit each end accurately, to be cemented on with a mixture of shell-lac, resin, and brick-dust, melted together; one of the caps having a longer arm branching from it than the other, being filed near its end, so as to admit the handle; after which, to keep the handle in its place, screw on a nut. Or a second way, thus:—Cut two pieces of hard-baked wood, so as to fit the ends of the cylinder with holes bored in the centre, to admit of a thick wire passing through; one end of the wire projecting more out from the cylinder than the other, through which pierce the handle, as before; the hooping to which the cushion is attached, to answer for a spring. The use of the silk flap, in my opinion, is to increase the electric fluid; the cushion should not be covered with it, but with leather; one end of the silk flap being

nailed across the top of the cushion, the other end hanging three parts over the cylinder. The ends of the conductor should be rounded off and soldered to the other part, and may be made of brass, copper, tin, or even paste-board, covered over with gold leaf or tinfoil; the forked end being fixed opposite the cylinder, so as not to touch it, the other end being brought near the knob of the Leyden jar. The Leyden jar should be coated with tinfoil three parts the way up, inside and out; after the apparatus is so placed, turn the cylinder. The fluid is collected from the cylinder by the forked end of the conductor, and passes out at the opposite end of the knob of the Leyden jar, charging it with the electric fluid. To discharge it, connect a brass chain to the bottom of the Leyden jar outside, one end being held by the person who is to receive the shock; the discharging rod having a handle of glass, to be held by the operator, while the chain, attached to the brass knob, is held in the other hand of the person receiving the shock. The operator now brings the knob of the discharging rod to the knob of the Leyden jar which discharges it, and gives the shock.

"T. L." may receive any information that I can give him, either through your valuable Journal, or by a letter, pre-paid, enclosing a postage stamp, directed to me.

I remain yours, &c.,

WILLIAM HOPKINSON.

BLUE ON STEEL.

To the Editor of the Penny Mechanic and Chemist.

SIR,—Seeing a very animated discussion in several of your past Numbers, on the subject of blueing of steel, I beg to say, that two or three months ago I had one of the blades of my penknife blued by being burnt in a candle; accidentally I touched it with a small drop of sulphuric acid, when, to my surprise, I found the blue colour had vanished, and, instead thereof, the steel had assumed a dark colour where it had been touched; afterwards I touched it again, and saw very plainly that the blue disappeared; when I immediately wiped the acid off, and the steel appeared in the same state as though it had not been blued at all; I then supposed, that the dark colour of the first observation was caused by the action of the acid on the steel, which I afterwards found was the fact. The blue colour disappears in about a quarter of a minute from the application of the acid.

If this should be thought worthy a space in your columns, and be thought any thing towards elucidating the subject, you are at liberty to insert it.

I remain yours, &c.,

FRED. BAKER.

EXPLOSION AT APOTHECARIES' HALL.

WE have this week to record a melancholy accident, which occurred on Saturday morning last, in the explosion of a quantity of fulminating mercury, which was in course of preparation at Apothecaries' Hall. It appears, that at the request of the Directors of the East India Company, the Apothecaries' Company had undertaken, contrary to their usual practice, the preparation of fulminating mercury, which, at the time of its explosion, was mixed with full one-third its weight of water. At the moment the accident occurred, it is believed that Mr. Hennell, the principal chemical operator in the establishment, was standing by a large block of wood, about three feet high, and about three feet in circumference, on which was placed a white evaporating dish containing the mercury. The situation of the apparatus was between the still-house and the gas-room, where gas was formerly manufactured for the use of the establishment, but which is now applied to other purposes. About 400 grains of the preparation had been taken from a steam-drying stove, at a temperature of about 115, by Mr. Hennell, in order to ascertain its strength. Two or three slight explosions were heard, occasioned by Mr. Hennell striking a grain or two in the still-house. Mr. Hennell then proceeded to the block of wood before-mentioned, for the purpose of mixing two parcels of the powder, when, from some cause—which, of course, cannot be explained—the explosion took place, striking Mr. Hennell immediately below the chest, and, taking an upward direction, carried away the right arm and the same side of the face, together with the whole of the upper part of the head, laying open the entire chest, and exhibiting the action of the heart and lungs. Some parts of the remains were scattered over the tops of the building, and other portions were actually picked up by the workmen upon the roofs of the adjoining houses. The deceased's right arm was found full twenty yards from the scene of the fatal event, and had, in its progress, indented, considerably, the leaden gutter-pipe. One of his fingers was picked up in Union Street, a distance of 100 yards, by a person passing at the time, and must have been

forced over the high building of the Hall. The labourers belonging to the Hall collected the scattered fragments, and deposited them in a spot set apart for their reception. Deplorable, however, as the accident has been, it is consolatory to know that no other person was injured, although three men were thrown down by the concussion. The glass contained in the whole of the window-frames (made of iron) was broken, by which, at least, some hundred panes were demolished, exhibiting a picture of destruction seldom witnessed. The block of wood upon which the dish containing the powder was placed, was so much splintered, as to appear as though it had been struck by electric fluid. The large paving-stone upon which the block stood, is, likewise, shattered into twenty pieces. About a yard square, in the middle of a wall nearly two feet thick, is thrown inwards four or five inches by the force of the explosion.

It may be as well, in order to allay any unnecessary fears that may have been occasioned to the neighbourhood by this alarming occurrence, to state, that in general no dangerous experiments are ever performed upon the premises of Apothecaries' Hall, and that they had only been undertaken in this instance at the especial and urgent request of the Directors of the East India Company. The whole of the preparation, 3 lbs. of which were intended for Bengal, and 3 lbs. for Madras, has disappeared by the explosion, not a single particle having since been found. There is not, at the present moment, any preparation upon the premises, from which the least danger can possibly arise.

ON RACKING THE EDGE OF A CIRCULAR PLATE, &c.

To "A. B."—Sir, It is extremely gratifying to me to find from your communication in the PENNY MECHANIC, Nos. 83 and 84, that my efforts to spread the seed of useful information, meet the approval of a practical man, like yourself. Unfortunately, I reside nearly 200 miles from the Metropolis; consequently I am deprived of the pleasure of a personal interview: if, however, you will be so good as to put your ideas and instructions on paper, respecting racking the edge of a *circular plate* for a *tangent screw*, I shall feel much obliged; and you can either leave the communication for me with the Editor of the PENNY MECHANIC, or direct the same yourself, to the "Rev. A. M., care of N. Prichard, bookseller, Builth, Breconshire, South Wales."

Being engaged on a work illustrative of the *lathe, its construction and application*, in all its various branches of ornamental and industrial manufacture, I am particularly anxious to render my book as practical as possible; to effect this, I invite free communications from those who have any information to bestow.

I am curious to know why you recommend an *angular*, instead of *a square*, thread, for endless screw; perhaps a thread of a cycloidal form would be better than either.

I remain yours, &c.,
AN AMATEUR MECHANIC.

MISCELLANEA.

Railway on Piles.—Our attention is called, by a correspondent, to a mode of constructing some railways in America, which deserves to be better known here. It is that of carrying the rails on strong longitudinal bearers, supported by piles four feet apart, at some height above the ground. It appears that 200 miles of the New York and Erie line, out of 400, have been constructed upon this plan, and also a large portion of the New Orleans and Nashville line, which is 500 miles long. According to the testimony of our correspondent, who is a gentleman of great respectability, the plan answers very well. Piles are driven by means of a pile-driving machine, worked by steam, to a depth in the ground, and with a rapidity and force, and consequent firmness of hold, hitherto unaccomplished. Lines of rails are thus carried over swampy and marshy ground, without any of that expensive process heretofore employed, and over some portions of the country with little or no trouble in levelling. The machine is that which was employed on the Surrey side of the New Hungerford Market Bridge. Six of these machines will drive the piles for seven miles of railway in a month, and, as we understand it, saw off the piles to their proper height, fit for laying down the longitudinals and rails. If such be the case, a line of railway might be laid down in a very few weeks. If this plan be carried out, certainly a vast expense in levelling, ballasting, purchase of land, &c., might be saved, and a great annual expense in the wear and tear of the road. Having succeeded so well in America, we think it is well worthy of the attention of our engineers.—*Railway Mag.*

Important Invention.—A French gentleman, Dr. Payerne, has just made a discovery in submarine experiments and

purposes. He has satisfactorily proved that he can descend and remain under water for any length of time, without communication with atmospheric air. He descended in the presence of several scientific men, in the diving bell of the Polytechnic Institution at nine o'clock, and remained there for three hours: when he ascended, he made no appearance of inconvenience. His process is, of course, a reproduction of the gases necessary to support life and also combustion, as was proved by his taking with him some candles, which he kept burning while below; and he intends applying it to salvage and submarine purposes, for examining dock-gates, foundations of bridges, ships' bottoms, &c., as soon as his patent is sealed.

Manufacture of Paper from Asparagus, &c.—Mr. Diercy, a paper-manufacturer of Ghent, has discovered, that the refuse end of asparagus makes excellent paper, at half the expense of paper from rags; and that a still greater economy is obtained, by mixing the pulp of asparagus with that of the beet-root.

The Mean Depth of the Sea is, according to Laplace, a celebrated author, from four to five miles. If the existing waters were increased only one-fourth by a convulsion of nature, it would drown the earth, and all terrestrial things would be swallowed up in a deluge. If the volume of the ocean were augmented only one-eighth, considerable portions of the present continent would be submerged, and the seasons would be changed all over the globe. Evaporation would be so much extended, that rains would fall continually, destroy the harvests, the fruits, and all vegetation, and subvert the whole economy of nature. W. W.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, June 15, J. S. Buckingham, Esq., on America. Friday, June 17, J. H. Pepper, Esq., on the Mechanical and Chemical Properties of Metals, and the Influence that Light, Heat, and Electricity, exert upon them. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, June 16, C. H. Purday, Esq., on Music, as an Imitative Art. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—Thursday, June 16, W. Hughes, Esq., F.R.G.S., on the Study of Geography. At eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, June 13, Mr. James Smith, on Taxation. At a quarter-past eight o'clock.

QUERIES.

How to make lenses for microscopic purposes? P. T.

Which is the best work to study Daguerreotype, where published, and the price? Also, whether I am to remove the ground-glass plate of the camera obscura, and put the silver plate in its stead? H. T. L.

Which is the best and most modern treatise on vapour, hot air, sulphur, and other medicated baths? Also, whether there is any means of softening hard spring-water for the purpose of washing, &c.? C. Roper.

The best way to make lemonade, such as the chemists sell in bottles? W. S. S.

What will be the best machinery to apply, in order to work two pairs of bellows (similar to the organ kind), one foot by one foot, to act alternately, so as to cause a constant pressure of air for twelve hours? Steam will not apply in this case, as the apparatus must be made as compactly, and at as cheap a rate as possible, and placed in a room. The air is intended to pass through small tin pipes of about half-inch bore. T. Jones.

The cheapest article to make paper waterproof, without oil, for packing purposes? Also, for making packing-boxes waterproof? Which is the cheapest article to prevent iron from oxidizing, without changing its colour? A. C. R.

1. In copying seals, casts, &c., by the electrotype, I find that the copper is precipitated in the form of a brownish-red-coloured powder; at other times in lumps of copper, which form chiefly round the edges of the cast; what is the reason of this, and how can I rectify it? 2. I have lately used the bichromate of potass for photogenic drawing, instead of nitrate of silver, and find it answer very well for taking copies of flowers, feathers, and leaves, &c.; but I cannot prepare paper in this manner, sensitive enough for obtaining views with a camera obscura; I wish to know if it can be done, and if so, how? 3. Where can I obtain potassium, and at what price? 4. What is the process of photographic drawing, and how does it differ from the photogenic? Can I make a fusible metal which will melt at a lower temperature than 190°, or at that temperature. H. Cowley.

Is there any book or other publication, which treats on the valuation of property and effects in general, and conveys instruction on that subject; also its price, and where it may be obtained? R. Harris.

ANSWERS TO QUERIES.

"W. B. W." Heat cautiously, in a retort, one ounce of binoxide of manganese in fine powder, with three ounces, by measure, of aqueous hydrochloric acid; put the acid first into the retort, and collect the chlorine gas at the pneumatic trough, having heated the water previously to

90°. Chlorine is condensed by cold water. Remove the retort when the gas comes slowly away, to prevent accident from the regurgitation, or swallowing back, of the water. This is apt to take place when the chlorine and the steam accompanying it are absorbed rapidly by the water.

J. W. D.

To Fix Photogenic Drawings.—Wash them with a very weak solution of iodide of potassium.

To Magnetise a Bar of Steel.—The simplest method of magnetising a bar of steel, is by placing it on a table as nearly as possible in the magnetic meridian—that is, nearly north and south—and holding over it, perpendicularly, a strong bar magnet, rubbing it throughout its whole length, beginning at one end and passing it along to the other, pressing it somewhat during its passage. After reaching the end of the steel bar, the magnet must be lifted up, and applied again to the other end, and so on for several times; the friction being always made in the same direction.

To Separate Alcohol from Wines, Beer, &c., without any distillation, or raising the temperature of the vinous liquor, may be done in the following manner:—Add to eight parts of the liquor to be examined, one part of a concentrated solution of subacetate of lead; a dense insoluble precipitate will ensue; it is a combination of the lead with the colouring extractive and the acid matter of the wine; shake the mixture for a few minutes, pour the whole upon a filter, and collect the filtered fluid. This fluid contains the brandy or spirit and water of the wine, together with a portion of the subacetate of lead, provided the latter has been added in excess; in which case a part, of course, remains undecomposed. Add, in small quantities at a time, to this fluid, warm, dry, and pure subcarbonate of potass, till the last portion remains undissolved. The brandy or spirit contained in this fluid will thus become separated; for the subcarbonate of potass attracts from it the whole of the water with which it was combined; the brandy or spirit of wine forming a distinct stratum, which floats upon the aqueous solution of the alkaline salt.

R. M. Ordish.

"Mechanic" can make a hole in common window-glass by means of a drill; taking care only to place a few drops of water where the drill acts. He can plate small brass ornaments readily by the electrotype.

"An Amateur." The pipes he requires would cost as follows:—

	£	s	d
Principal through ..	7	0	0
Dulciana to tenor C	8	0	0
Stopt wooden bass	6	0	0
	21	0	0

"Tyro." Organ-pipes, whether open or stopt, are never nicked on the cap. Metal pipes sometimes appear so, from the back of the knife having marked the part while nicking the tongue. Middle C of an open flute should be twelve inches long, about an inch from back to front, and one-fifth less from side to side. It is tuned by being cut down until rather sharp, and then regulated by a piece of metal being attached to the back at top, and pressed down, so as to partially cover the opening at top. Middle C of a stopped flute should be about six inches and a half long, and of the same size in breadth and depth as the open flute, and is tuned by the plug, as in the stopt diapason.

G. S., Jun.

"K. Y. L." I should imagine arsenic would deposit from any matter in which it is held in solution, in the same way that copper does, by the aid of galvanism, forming a very correct test for its presence.

W. C., Jun.

TO CORRESPONDENTS.

J. F. P.—*According to the last edition of the London Pharmacopœia, sodæ subcarb., sodæ sesquicarb., and sodæ bicarb., are the same, and are the new names for the common carbonate of soda. The salt which is commonly known as subcarbonate of soda or prepared natro, is, by this edition, called sodæ carbonas.*

To make iodic acid, diffuse iodine in water, and pass chlorine gas through the mixture, until it becomes clear and colourless. Evaporate to a semi-transparent white saline mass.

S. T. W. *wishes to know why a stone sinks to the bottom, if the pressure of water upwards be equal to that downwards. This is described in Joyce's "Mechanics:"—"The stone endeavours to descend by the force of gravity; but it cannot descend without moving away as much of the water as is equal to the bulk of the stone; therefore it is resisted or pressed upwards by a force equal to the weight of as much water as is equal in magnitude to the bulk of the stone; but the weight of the water is less than that of the stone, consequently, the force pressing against it upwards, is less than its tendency downwards, and it will, therefore, sink with the difference of these two forces."*

J. Tapson.—*We will endeavour to supply him with the information he requires, in the course of a few weeks. He is, no doubt, aware, that the experiments necessary to obtain a satisfactory result, ought to stand over some length of time. His communication contains some important hints on the subject, which we hope to put into such a form as will benefit our readers.*

A Gunmaker.—*We think he can make gun-barrels a darker brown, by attending to the method described in the January Number of* 1839; *but using the proportion of one ounce and a half of tincture of steel, instead of one ounce. The operation should be performed four or five times over, which would no doubt produce a colour sufficiently dark.*

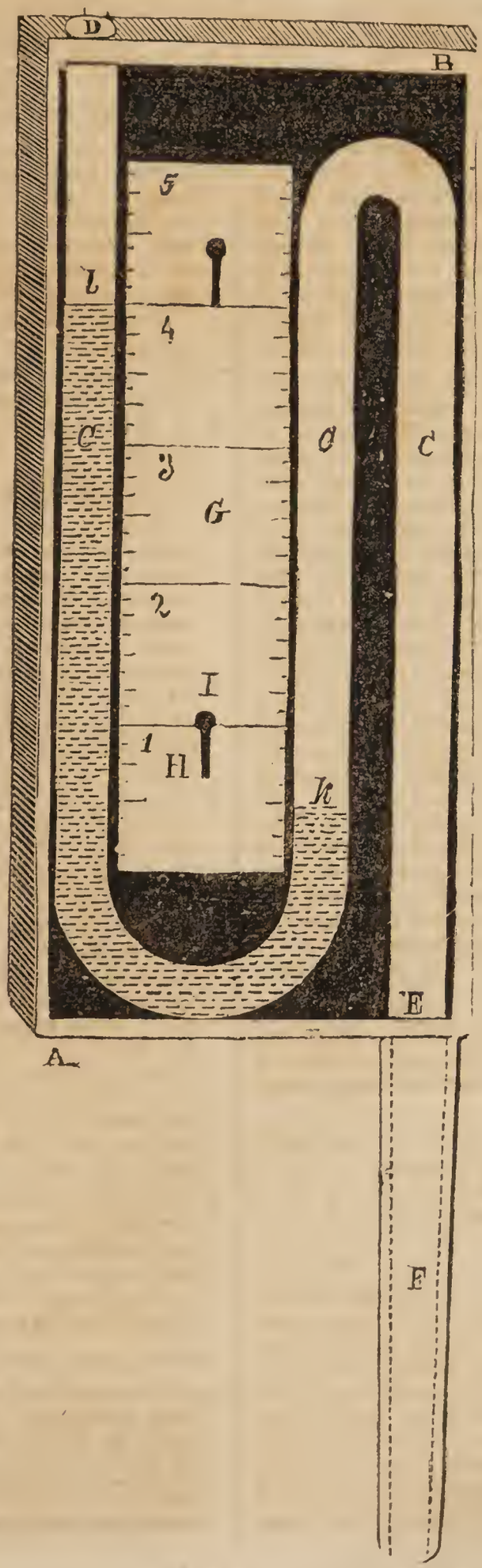
A Subscriber.—*Liquids can hardly be said to be absolutely incompressible, inasmuch as they yield slightly to very intense pressure. He will find an article on the compressibility of liquids in Nos. 8 and 9 (double No.) of the 4th Volume of the* Penny Mechanic.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.

No. **87**, THIRD SERIES. } SATURDAY, JUNE 18, 1842. { No. 335, OLD SERIES.

WEIGHT-OF-WIND GAUGE.



ol. VIII.—No. 28.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

WEIGHT-OF-WIND GAUGE,

FOR ASCERTAINING THE WEIGHT REQUIRED ON ORGAN-BELLOWS.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

SIR,—Finding, from the number of questions addressed to me, both through the medium of your Journal, and privately by letter, that there are many of your readers engaged in building organs, I have sent you the sketch of an instrument which it is necessary to have, in order to know how to regulate the weight with which to load the bellows. I will first describe how to make the gauge, and, afterwards, the way to use it:—Make a small box, A B, of mahogany, or any hard wood, about six inches long, two inches and a half or three inches wide, and half-an-inch deep inside; cover the bottom, inside, with white paper (in the diagram it is blackened, in order to exhibit the other parts more clearly), then procure a piece of moderately thin glass tube, of about three-eighths of an inch in the bore, and fifteen or sixteen inches long, and bend it in the form as shown at C C C, in the diagram. Place it within the box, so that one end may enter the hole at D, and the other the hole at E, and fix it there by means of a little sealing-wax, or resin and bee's wax, put previously on the outside of the ends of the glass tube. At the same hole, E, but on the outside of the box, must be affixed a small wooden tube or foot, E, made like the foot of one of the wooden pipes, and having a bore of about the same size as the glass tube. The joint between this and the glass tube must be made air-tight. Next take a thin slip of brass or ivory, G, about four inches and a half or five inches long, and about three-fourths of an inch broad, and graduate it on both edges in inches and eighths; cut two little slits, H H, and affix it to the back of the box by means of two little screws, I I, so that it can be shifted a little either up or down. The gauge will then be complete, by the addition of a lid to cover the box, when not in use.

By the term weight of wind, is meant the actual force with which it is blown into any of the pipes, and not the weight that is placed on the bellows. The larger the bellows, the greater the weight necessary to cause it to issue forth with the same force, and *vice versâ*. This force is measured by the height of a column of water that it will sustain.

To make use of the gauge, pour in some water at the hole, D, until it stands about half-way up the tube. It is better to colour it by the admixture of a little port wine, as that will not much affect the gravity of the water. Remove any one of your pipes from the rack, and place the gauge, with its foot, where the pipe stood. On drawing the stop and pressing the key that would have made the pipe that is removed, speak, the coloured water will be forced down in the centre part of the tube, and up in the side part. The distance between the two surfaces of the water, is the weight of wind. This is readily measured, by sliding the graduated piece of brass up or down, so as to make any of the divisions coincide with one of the surfaces of the water. About three inches and a half is the usual weight of wind required. Those who understand the principles of hydrostatics, will, of course, readily perceive, that the bore of the glass tube is of no consequence, except as far as convenience goes.

I remain yours, &c.,

G. S., Jun.

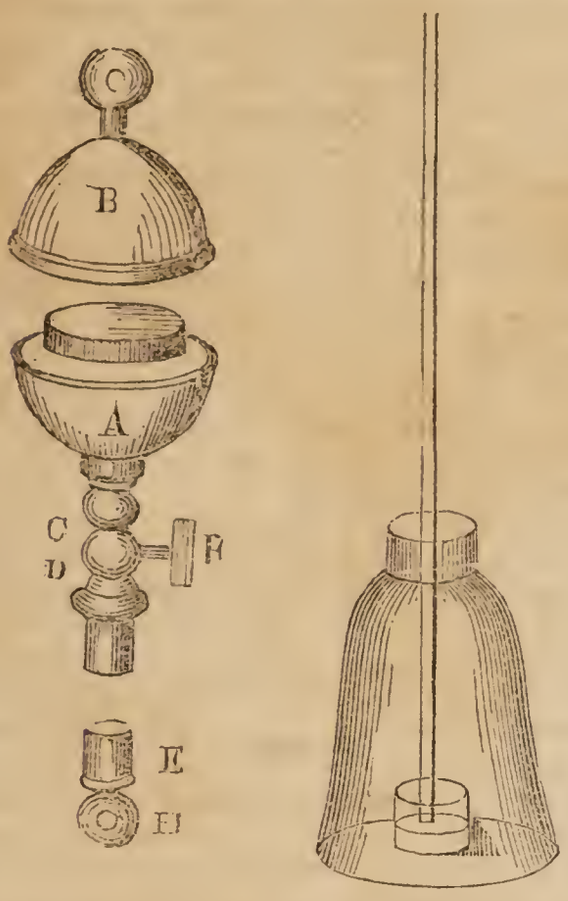
PNEUMATICS.

No. V.

Experiment. 5.—Join the two hemispherical cups, A and B, together, with a wet leather between them, having a hole in the middle; then screw the end, D, of the pipe, C D, into the hole of the pump-plate; then turn the cock, E, so that the pipe may be open all the way into the cavity of the hemispheres; exhaust the air out of them, and turn the cock a quarter round, which will shut the pipe, C D, and keep out the air. This done, unscrew the pipe at D, from the pump, and screw the piece, F, upon it at D. Let two persons try to pull the hemispheres asunder by the rings, G and H, which they will find difficult to accomplish, owing to the pressure of the external air upon them. To prove, then, that it is the pressure of the air that keeps them together, hang them to a hook in the receiver by either of their rings, place the receiver on the pump-plate, and, upon exhausting the air out of the receiver, the hemispheres will fall asunder of themselves.

Experiment 6.—Having placed the small jar, A, with some quicksilver or mercury in it on the pump-plate, cover it with the receiver, B; then push the open end of the glass tube, *d e*, through the collars of the leather, in the brass neck, C (which it fits, so as to be air-tight), almost down to the mercury in the jar; then exhaust the air

out of the receiver, and it will come also out of the tube, because the tube is closed at the top. Now push down the tube, so as to immerse its lower end into the mercury in the jar. Now, although the tube



be exhausted of air, more of the mercury will rise into it, because there is no air left in the receiver to press upon its surface in the jar; but let the air into the receiver, and the mercury will immediately rise in the tube, and stand as high in it as it was pumped up in the last experiment. These experiments thus show, that the mercury is supported in the barometer by the pressure of the air on its surface in the box in which the open end is placed; and, also, that the more dense and heavy the air is, the higher does the mercury rise; and, on the contrary, the thinner and lighter the air is, the more will the mercury fall: for if the pump-handle be turned ever so little, it takes some air out of the receiver, by raising one or other of the pistons in its barrel; and, consequently, that which remains in the receiver is so much the rarer, and has so much the less spring and weight, and, therefore, the mercury falls a little in the tube; but, upon turning the cock, which is attached to the air-pump, and re-admitting the air into the receiver, it becomes as weighty as before, and the mercury rises again to the same height. Thus we see the reason why the barometer falls before rain or snow, and rises before fair weather; for, in the former case, the air is too thin and light to bear up the vapours; and, in the latter, too dense and heavy to let them fall.

Experiment 7.—Take the tube out of the receiver, and put one end of a bit of dry hard branch, about an inch long, tight into it. Fix the other end tight into the bottom of a small wooden cup; fill this cup with mercury, and exhaust the receiver of air, and the pressure of the outward air on the surface of the mercury, will force it through the pores of the hazel, from whence it will descend, in a beautiful shower, into a cup placed under the receiver to catch it.

G. STARKEY,
Mineralogical Chemist.

THE AXLES OF LOCOMOTIVE ENGINES.

THE accident on the Versailles Railway, by the breaking of the front axle of a four-wheeled locomotive engine, having given rise to some difference of opinion, as to what would be the effect of a broken front axle of the four-wheeled engines used in this country on the London and Birmingham, the Eastern Counties, the Midland Counties, the North Union, and other railways using this description of engine, the London and Birmingham Railway Company, with their usual liberality, undertook some experiments for this purpose. The object was to ascertain the effects of a broken fore axle, and whether anything could be suggested from these effects which could increase the public safety. As no front axle of this kind of engine had ever been known to break, it was determined to cut one, so as to insure its breaking. Accordingly, a few days since, the fore axle of one of the ordinary passenger-engines was cut nearly through its entire thickness, at a short distance from one of the bearings (as being the most severe test), and was started from Wolverton without any load. The engine ran eight miles, and it was then examined, and the axle found to be broken quite in two. The engine was then crossed over to the other line of rails (passing through the point), and returned back to Wolverton, without any accident whatever. The next day the engine, precisely in the same state in which it had been left on the preceding day, was started from Wolverton with a train of six loaded luggage-trucks attached, weighing about thirty-five tons, and it proceeded, without stopping, to Watford, a distance of thirty-four miles. At this time the speed was twenty-five miles an hour, when one of the four wheels slipped inside the rails; but the engine

exhibited no signs of breaking down. The wheel was replaced on the rail, and the engine again started and ran twelve miles farther, when one of the fore wheels, and both the driving wheels, slipped off the rails, and the engine ran 200 yards over the cross-sleepers, but without the slightest indications of breaking down. The wheels were again replaced on the rails, and the engine then ran safely to Camden Town, a distance of fifty-two miles, which it accomplished in three hours and a half, including all the time lost in twice replacing the wheels on the rails. The total distance run by the engine after the axle was broken quite through, was upwards of sixty miles; and the experiment is considered to afford the most satisfactory evidence of the perfect safety of the four-wheeled engines, when made with inside bearings. The fracture of the crank axles of these engines has several times been proved to be perfectly harmless; as instances have occurred of four-wheeled engines running seven miles with a broken crank axle; while it is said that six-wheeled engines are immediately disabled under similar circumstances.

DR. PAYERNE'S EXPERIMENT IN THE DIVING BELL.

To the Editor of the Penny Mechanic and Chemist.

Sir,—In your Magazine of the above date, you have an article entitled "Important Invention," giving an account of Dr. Payerne's experiment in the diving bell of the Polytechnic Institution, in which he remained for three hours without communication with the atmospheric air. This is a very singular discovery, and it is to the means adopted to purify the air, that I wish to call your attention.

It has been pretty generally supposed, that the Doctor decomposed the water, and, having obtained his oxygen, purified the air with it; and, in support of this idea, he was observed to take with him, in his descent, a "something," which was imagined by many to be a galvanic battery.

Now at a lecture given at the Polytechnic a few days since, it was stated by the lecturer that, "in order to decompose one grain of water, the battery required for the process must be so strongly charged, as to be sufficient to cause instant death;" and as Dr. Payerne's apparatus went in a very small compass, perhaps this induced the suspicion that the Doctor used no apparatus whatever. Two of the attendants of the Institution, thinking this to be the case, descended in the bell, without taking any apparatus of any kind. They remained there for one hour and a half (equal to the Doctor's three), without feeling the slightest inconvenience.

I remain yours, &c.,

T.

HISTORY OF MEDALS.

(Continued from page 212.)

Medals are formed of gold, silver, and the various modifications of copper. The gold usually made use of in coinage, is about the fineness of twenty-two carats; and as the art of purifying this metal was very much unknown in former times, the most ancient medals are, for this reason, much more impure than the modern coins. Gold is never found, in its native state, above twenty-two carats fine; and the very ancient medals are much under that standard. Many of them are composed of a mixture of gold and silver, called by the ancients *electrum*. The gold medals were made of much finer metal, after Philip, of Macedon, became possessed of the gold mines of Philippi, in Thrace; and the medals of his son Alexander the Great, are equally fine; as well as those of some other princes of that age. Those of the Egyptian Ptolemies are of the fineness of twenty-three carats three grains, with only one grain of alloy. The Roman coins are very pure, even from the earliest times; the art of refining gold being well known before any were coined at Rome. Some authors are of opinion, that the Roman coins begin to fall short of their purity after the time of Titus; but Mr. Pinkerton denies that anything of this kind takes place till the time of the Emperor Severus; and even then only in a very few instances. Most of the Roman gold was brought from Dalmatia and Dacia, where that metal is still to be met with. A very remarkable circumstance is observed in the eastern part of Hungary, which belonged to the ancient Dacia. It germinates in the vines of Tokay, and is found in their stems; as it is elsewhere in the straw of corn.

Pliny informs us, and, indeed, it is generally known, that gold and silver are found mixed together in the earth. Where the silver amounted to one-fifth part of the gold, the metal was called *electrum*; but sometimes the quantity of silver was added artificially. The gold was in those days, as well as at present, refined by means of mercury; and the ancient artists

had certainly attained to great perfection in this branch of metallurgy; as Bodin tells us, that the goldsmiths of Paris, upon melting one of Vespasian's gold coins, found only $\frac{1}{788}$ part of alloy.

Most of the ancient silver, particularly that of Greece, is less pure than that of succeeding times; even the Roman silver is rather inferior to the present standard, and that from the very beginning; but in the time of Severus, the silver appears very bad, and continues so until the time of Dioclesian. Many writers upon this subject have mistaken the *denarii ærei*, "coins of brass washed with silver," for silver currency. Silver coins are extremely scarce from the time of Claudius Gothicus to that of Dioclesian, or from the year 270 to 284; in which short space no fewer than eight emperors reigned. Silver, at that time, was found mostly in Spain; and the commerce with that country was disturbed by the usurpers, who arose in Gaul; and such were the troubles of the times, that not only the silver, but also the gold coins of those eight emperors, are extremely scarce. There is still, however, some silver extant of those eight emperors; and it is certain, that copper washed was never used as silver currency, but was entirely a distinct coinage. Occasional depravations of silver had taken place long before; as Pliny tells us, that Mark Antony mixed iron with his silver denarii; and Mr. Pinkerton informs us, that he had seen a denarius of Antony, which was attracted by a magnet.

The ancient brass coins consist of two kinds—the red or Cyprian, which, indeed, is no other than copper, and the common yellow brass. Our author observes that, in the Roman coinage, brass was of double the value of copper, and he is of opinion, that it was the same among the Greeks; and the latter is the metal most commonly made use of in the Greek coinage. The Roman sestertii were always of brass: the middling-size kind are partly copper and partly brass; the former being double the value of the latter, which are the *ases*.

ARSENIC.

Arsenic is a metal scattered, in great abundance, over the mineral kingdom. It is found in black heavy masses, of little brilliancy, called native arsenic (testaceous arsenic). This exists in different parts of Germany. Mineralized by sulphur, it forms sulphurized arsenic, or orpiment. This mineral is met with in Italy, about Mount Vesuvius. There are two varieties of this ore, which differ from each other in colour, occasioned by the different proportions of its component parts. The one is called yellow sulphurized arsenic or orpiment; the other, red sulphurized arsenic, or realgar (ruby arsenic); both are met with in Hungary and different parts of Germany. The colour of the first ore is a lemon yellow, inclining sometimes to a green; the colour of the latter is a ruby red; it is more transparent than the former, and found in compact solid masses, sometimes crystallized in bright needles. Arsenic, united to oxygen, constitutes the ore called native oxide of arsenic. This ore is scarce; it is generally found of an earthy appearance, or as an efflorescence, coating native or metallic arsenic. Its colour is a whitish grey; it is rarely met with crystallized. Arsenic exists, likewise, alloyed with cobalt, antimony, tin, copper, lead, and various other metals.

Arsenic is a brittle metal, and, in the recent fracture, of a lively bright colour, between tin-white and lead-grey; but, on exposure to the air, it soon loses its metallic lustre, and turns prismatic, dull, and, at last, black. Its specific gravity is between 8.310 and 5.763, according to its texture. Its hardness surpasses that of copper; but its ductility is so little, and its brittleness so great, that it is readily converted into a powder by the hammer. It is entirely volatilized when heated to 356° Fahr. It sublimes in close vessels, and then crystallizes in tetrahedra or octahedra. When heated with the access of air, it emits a strong smell of garlic, and burns with a blueish-white flame. It combines with sulphur by fusion. It unites to phosphorus, and combines with most of the metals. It gives a white colour to copper, and renders many of the ductile metals brittle. When mixed with hyper-oxygenated muriate of potash, it detonates strongly by the stroke of a hammer. It is soluble in hydrogen gas by heat. It does not decompose water alone. It decomposes sulphuric acid by heat. The nitric and nitrous acids oxidate it rapidly. The muriatic acid attacks it with heat. The oxygenated muriatic acid, when in a gaseous state, inflames it instantly. It is nearly unalterable by the fluoric, boracic, phosphoric, and carbonic acids. It unites with alkaline sulphurets and hydro-sulphurets. It is a deadly poison.

In order to obtain metallic arsenic, mix two parts of the white oxide of arsenic of commerce, with one of black flux (obtained by detonating one part of nitrate of potash with two of acidulous tartrite of potash), and put the mixture into a cruci-

ble or melting-pot. Invert over this another crucible, lute the two together with a little clay and sand, and apply gradually a red heat to the lower one. The oxide of arsenic will be reduced, and be found lining the upper crucible in small crystals of a metallic brilliancy.

The charcoal of the black flux takes, in this process, the oxygen from the white oxide, and forms carbonic acid gas, which flies off during the process, and the oxide becomes reduced to the metallic state. This reduction of the oxide is greatly facilitated by the alkali of the flux.

In order to obtain arsenic in a state of absolute purity, the metal, before obtained, must be reduced to powder, dissolved by heat in nitro-muriatic acid, and then precipitated, by immersing into the solution a plate of zinc. The arsenic is thus precipitated in a fine powder, and may be reduced to its metallic state, by exposing it in a covered crucible to a moderate heat. If it be kept under water, its metallic brilliancy may be preserved. This effect is still better produced by alcohol.

Arsenic and its various preparations, are the most active of all poisons. A nausea, sickness, and retching, commonly ensue in half an-hour after taking it, followed by violent vomitings, hiccough, and pains in the stomach and bowels; convulsions and palsies of the limbs presently succeed, with intense heats, cold sweats, palpitations of the heart, extreme anxiety, prostration of strength, thirst, and dryness of the mouth and throat; loss of reason, and, at last, death. If the quantity taken has been considerable, the stomach and intestines are often found, upon dissection, corroded or perforated, and the blood is fluid, though, in general, the patient expires before the action of the poison has proceeded to such a length. After death, the body runs into sudden putrefaction. When the quantity taken does not prove fatal, it occasions tremors, palsies, or lingering hectics, and, in the end, death.

To detect the presence of arsenic, whether taken by design, the wickedness of others, or imprudence, it is necessary to throw the contents of the stomach on live coals, when a garlicky smell is immediately obvious. On polished copper, if heated between its plates, a white spot is impressed; or, in close vessels, the arsenic itself will be found sublimed in the upper parts. In the stomach, however, there are many substances which may resemble or disguise the smell of arsenic, especially if the arsenic be in small quantities. We are, therefore, advised by Hahneman, to boil the contents of the stomach of the person supposed to be destroyed by this poison, in a large quantity of river water; to add to one-third of the filtered liquor, hot and limpid lime-water; to another third, water saturated with hepatic gas; and to the remainder, a solution of copper in pure aqua ammoniæ. Each fluid is rendered turbid, if the suspected contents contain arsenic, and the sediment, thrown on live coals, emit the odour of garlic. The sediment of the lime-water is again dissolved by a recent solution of arsenic; the orange-coloured sediment, from the hepatic gas thrown on the coals, takes fire, and the smell of sulphur is observed previously to that of the garlic; while the yellow-green sediment of the copper is soluble in pure ammonia and acids of every kind.

The earliest chemists were embarrassed in the determination of the nature of the poisonous white substance known in commerce by the name of white arsenic. Subsequent experiments have shown that this substance is metallic arsenic, oxygenated in the first degree. The name of arsenious acid is, therefore, given to it. It is sometimes found in nature in sublimed crystals, in volcanoes; and in masses or in stalactites, among the ores of arsenic, cobalt, bismuth, and nickel.

It possesses a weak subacid taste, which slowly manifests itself. Though of but a feeble acidity, it sensibly reddens the tincture of cabbage and litmus. If placed on burning coals, or on a red-hot iron, it is volatilized in the form of a white vapour, which has a strong smell of garlic. It is slightly soluble in water. With phosphoric and boracic acids, it fuses into glass. It decomposes the nitrates and the superoxygenated muriate of potash. It unites with many of the earths and alkalies, and forms saline compounds.

Methods of obtaining Arsenious Acid.—1. Pulverize arsenic, and put as much of it into a Florence flask as will fill it about one-half or less. Introduce a little tow or cotton into the neck of the flask, and apply the heat of a lamp. A dense white smoke will be formed, and become precipitated on the internal sides of the flask. If the process be kept up till all the arsenic be oxidated (which may be known by introducing a wire into the flask for a moment, which will become covered with a white crust, if the sublimation be not completed), and the heat be then gradually augmented, the sublimed arsenious acid undergoes a sort of fusion, and an opaque white mass, similar to that met with in commerce, is obtained.

2. The arsenious acid of the shops, or white arsenic, is chiefly obtained from arsenical ores of cobalt. These ores are thrown into a furnace, resembling a baker's oven, with a long flue or chimney, either horizontal or winding, into which the fumes pass, and are condensed into a greyish or blackish powder. This is refined by a second sublimation, in close vessels, with a little alkali to arrest the impurities. As the heat is considerable, it melts the sublimed arsenious acid into those opaque crystalline masses, which are known in commerce by the name of white arsenic. Arsenious acid, united with different bases, forms salts called arsenites.

MISCELLANEA.

Experiments with Large Guns at Deal.—The preparations for making experiments on an extensive scale with large guns on the coast, betwixt Sandwich and Deal, are now nearly completed, and the experiments will be commenced in the course of the next or following week. Major Hardinge, K.H., and Captain Fyers, of the Royal Artillery, have proceeded to Deal, the latter to join Major Macbean's company, by whom the experiments will be carried on. Major Hardinge, as senior officer, will have charge of the whole, and, from his great practical knowledge as an artillery officer, will be able to give correct report of the details, and how far they may be likely to prove of an advantageous nature to the military and naval services of this country. The Lords Commissioners of the Admiralty and the Board of Ordnance, have acted with a spirit of liberality in this matter worthy of the heads of these important branches of her Majesty's service, and have spared no personal exertion in addition to the fullest instructions for carrying the experiments on in a most effectual manner. Several large guns have been mounted on ship carriages at Woolwich, and forwarded to Deal with fifty rounds of balls and cartridges for each. A great number of magnificent guns of large calibre, capable of containing solid shot of 130 lbs. weight, were recently cast at the foundry of Messrs. Walker and Co., for Mehemet Ali, and proved at the Royal Arsenal, Woolwich. The founders of these guns having expressed a wish to have the range of one of these tried to its utmost extent, their desire has been complied with, and a suitable ship carriage, and one of Messrs. Walker's guns, will be forwarded to Deal for this purpose. A thirty-two-pounder gun, weighing fifty-nine cwt., and a splendid thirty-two pounder, brass howitzer, constructed on a plan of Lieut.-Col. Dundas, Inspector of Artillery, will also be forwarded, at the same time, for the purpose of having their qualities reported on.

The Planet Mercury.—A favourable opportunity is now afforded, for observing this rare and interesting object. Being very near Venus (a little below it), it may readily be discovered on the western horizon by the naked eye, about nine o'clock in the evening; and, by the help of an ordinary telescope, steadily supported, a clear view may be obtained.

A Curious Index.—At a late meeting of the Institution of Civil Engineers, a paper was read by the Rev. Mr. Clutterbuck, on the periodical drainage and replenishment of the subterranean reservoirs, from which the wells of London and the surrounding country are supplied. The author stated the curious fact, that the weekly depression of the London wells is about five inches. It is said, that unless some periodical rest were afforded, the supply would altogether cease. This periodical cessation of demand occurs every Sunday. The author states, that on Sunday, during the cessation of pumping, the original level is generally nearly resumed. As a general rule, the author stated, "that the holidays of the Metropolis ought to be known by the relative heights of water in the wells at some distance from it." The observations which have led to this very curious discovery, were made in the neighbourhood of Colnbrook, part of which district is covered by the London and plastic clays, and where a series of observations have been made on the wells. Any considerable increase in the number of London wells, or those of the surrounding country, it is said, would immediately affect those already sunk.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, June 22, J. S. Buckingham, Esq., on America. Friday, June 24, R. Adams, Esq., on Acoustics. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, June 23, C. H. Purday, Esq., on Music as an Imitative Art. At half-past eight.

Philosophical Institution, Beaumont Square, Mile End.—(Date not fixed). F. B. Barton, Esq., B. A., has consented to give two Lectures,

accompanied by Readings from various Poets and Dramatists, Grave and Humorous, with a view to render this kind of Reading more generally practised as a means of Improvement and Amusement. At eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, June 20, Mr. Bilbrough, on Horology. At a quarter-past eight o'clock.

QUERIES.

Sir,—Having been a reader of your valuable publication from its earliest date, I beg leave to tender you my best thanks for the ready facility you have afforded your correspondents in their inquiries after all kinds of scientific and useful information which they may have wished to possess themselves of, and am happy to perceive the prompt manner in which their calls have been responded to, and, in many cases, by affording the newest and best means of carrying the objects inquired after into effect. Now I, for one, shall be greatly obliged to any gentleman that can and will inform me, through the medium of your pages, the best method of constructing an electro-magnetic machine of the most powerful kind in general use, adapted for medical and experimental purposes, with a description of the apparatus used; that for medical purposes more particularly. I wish to know the length and gauge of the primary wire; also of the secondary, as adopted by professional makers, or found by them best in practice; for, by what I can understand, both of these wires may be made either too long or too short, or may be too thin, in proportion to each other, to produce the greatest and best effect. Several arrangements of this kind of machine and apparatus, with directions for use, are sold by different makers, I believe, at from three to six guineas each; and as these instruments are new in science, and there not being any plain elementary descriptive work published upon them—similar to Cuthbertson, or several others, on frictional electricity—that I am aware of (if there be, I should be glad to see the title and price noticed); consequently, a person in the country neither knows how to spend his money in purchasing, nor his time and expense in making one, to any satisfactory and certain purpose, that he is securing the best known principle. In December, 1840, Mr. S. Chick favoured your pages with a description of a machine of the kind inquired after (no doubt a very good one); but I wish to know, if possible, the most powerful arrangement, and if there be any one superior to that; not having had an opportunity of becoming acquainted with such machines myself, so as to be able to judge of their several merits satisfactorily, by what I have read and heard of them.

The best and quickest method of obtaining oxygen gas for immediate use? J. W. D.

How to make a universal and curval chuck, and what each may be bought for that would do for a lathe; head stocks four inches to the centres? Also, the most improved plan for making an eccentric chuck? W. Rotterill.

How to take the fac-simile of a medallion by the lathe? J. H.

I should feel greatly obliged to any of your scientific correspondents, who will inform me of the difference of expansion in metals; for instance, a compensation-clock pendulum, or a compensation balance to chronometers, &c. I wish to know how steel and brass are affected by the change of the seasons; also, if gold and silver be alike affected by the change of winter and summer. In a compensation clock pendulum, does the steel contract and the brass expand both at the same time; thus keeping the pendulum in a fixed situation? Is there any benefit in Mr. Dent's patent chronometer spring being coated with gold—i. e. does it prevent any action of the weather upon the steel spring? J. W.

The method of gradating or tuning the pieces of glass, composing the musical boxes that are sold in the shops, beginning from D below the staff, to D in alt, comprising two octaves? T. F. B.

How to take sulphate of copper from linen? Likewise, how to take sulphuric acid from a solution of sulphate of copper? N. N.

ANSWERS TO QUERIES.

Mr. Marsh's Plan for Detecting Arsenic.—The following is the apparatus of Mr. Marsh for detecting arsenic:—It is made of a bent glass tube, with a lip at both ends, one arm being three or four inches longer than the other. Into the shorter arm, a piece of zinc is suspended by a thread, so that it shall not quite touch the bottom of the tube. The liquid suspected to contain arsenic, has a little sulphuric acid mixed with it, and a portion is poured into the longer arm. The stop-cock being open, the liquid will occupy the short arm; but hydrogen gas being formed by the contact of the acid and zinc, this will ascend, and the stop-cock being shut, it will accumulate. Upon being let off, and a light applied, the gas will take fire; if the liquid contain arsenic, the light will tinge of a purplish metallic stain; a piece of glass held close over it, with common hydrogen, no stain will be perceptible. Petifer.

TO CORRESPONDENTS.

W. H. G.'s *letter was forwarded to the party he named, but, as yet, no reply has been received by us. He shall hear from us as soon as we can obtain a satisfactory result.*

E. B. F.'s *communication will not suit our pages; we must, therefore, decline inserting it. If he wish the MS. returned, he must call at our office, as he has not given his address.*

If J. Arnold, Jun., *would endeavour to write with a little less bitterness of spirit, we might give more attention to his epistle. We cannot deny that much of what he says is true; but its being made known could not be of service to any one, nor would it please our readers.*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.
A MAGAZINE OF THE ARTS AND SCIENCES.

Nos. 88 & 89, THIRD SERIES. | SATURDAY, JUNE 25. PRICE TWOPENCE. | Nos. 336 & 337, OLD SERIES.

PORTABLE CARD-DIAL.

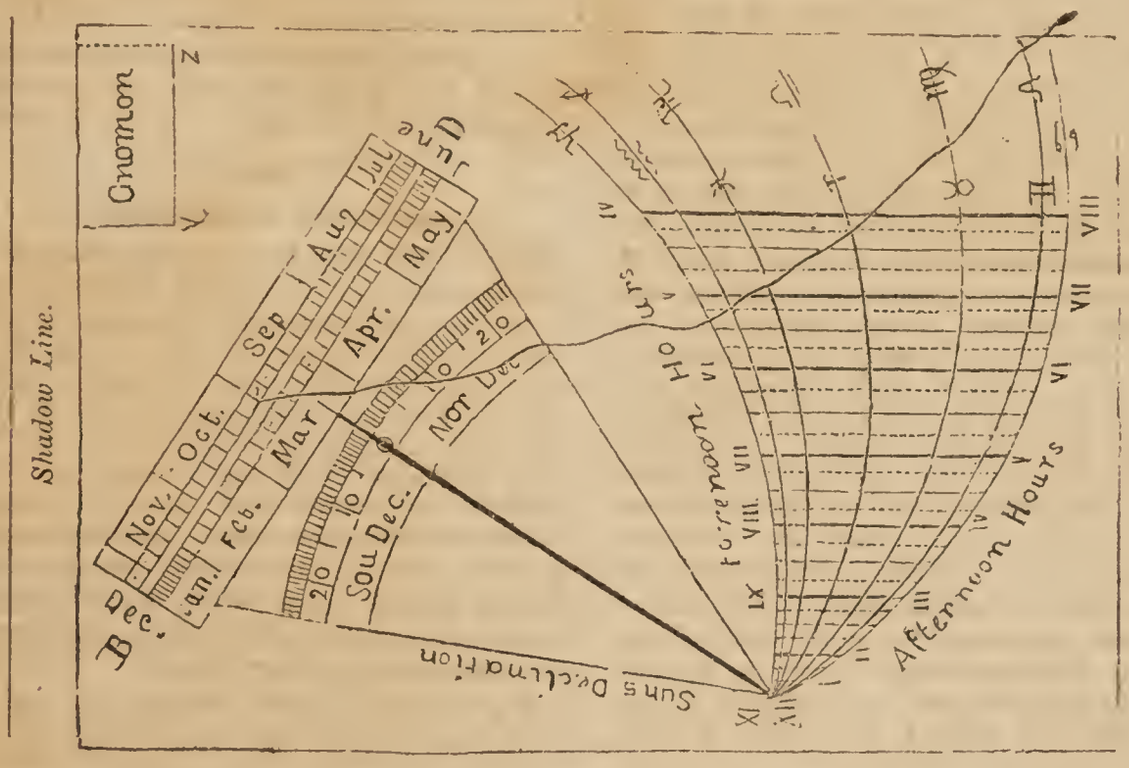


FIG. 2.

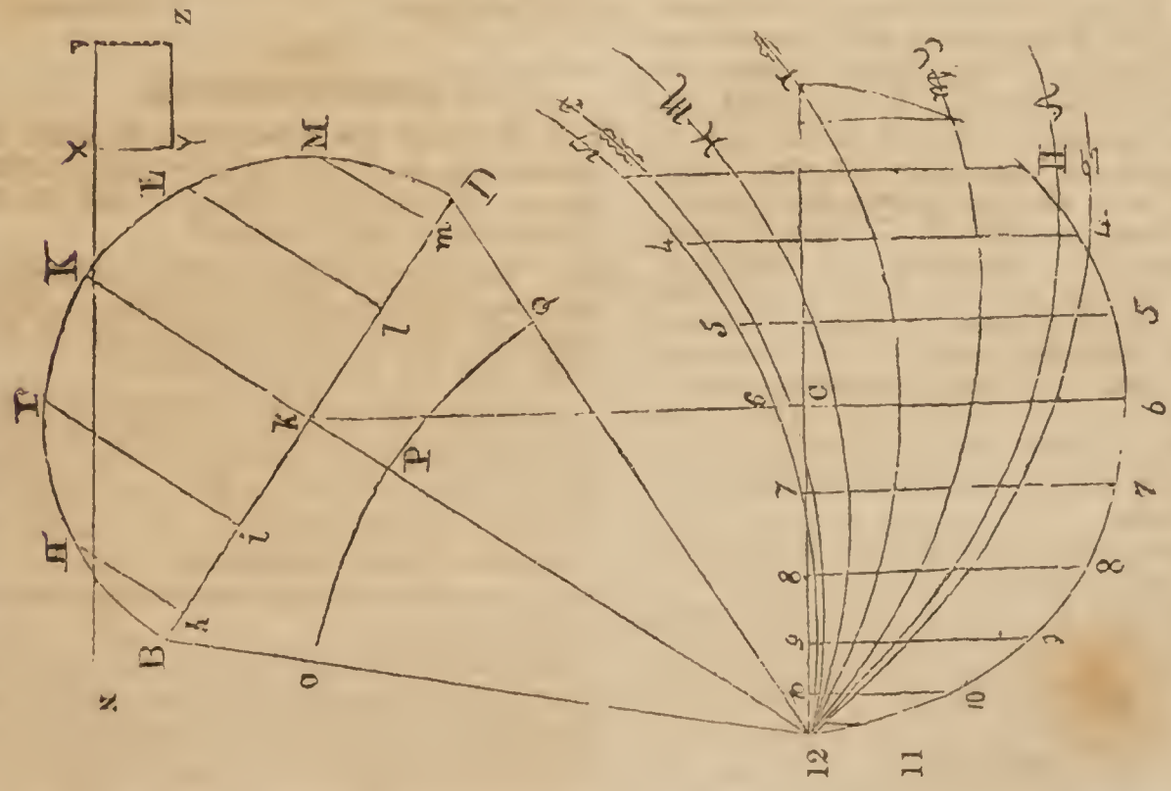


FIG. 1.

Vol. VIII.—Nos. 29 & 30.] City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

PORTABLE CARD-DIAL.

(See Engraving, front page.)

This curious and ingenious dial is said to have been originally invented by a Jesuit. It was denominated the Capuchin, because it resembles the head of a Capuchin friar, with an inverted cowl.

Description of the Engravings.

Fig. 1 shows the geometrical construction of the dial, and is executed in the following manner:—About two-thirds from the top of the card, draw the line, 12 C A, parallel to the top, and another line, *k* C 6, bisecting it at right angles. With centre, C, and distance, C 12, or C A, describe the semicircle, 12 6 A, and divide it into twelve equal parts at the points, 11, 10, 9, 8, 7, &c. From these points draw lines, 11, 11; 10, 10; 9, 9; &c., perpendicular to the diameter, 12 A, and they will be the hour lines. The half-hour and quarter-hour lines may also be drawn, by dividing each arc into two, and then into four equal parts. From 12, draw 12 *k*, making the angle, C 12 *k*, equal to the latitude of the place (which, in the plate, is Glasgow, in lat. 55° 56′ 10″ N.); let this line meet the six-hour line in *k*, through which draw the line, B *k* D, perpendicular to 12 *k*. From the point, *k*, draw the lines, 12 B, 12 D, each equal to 23½°, the sun's greatest declination. These lines determine the length of B D, which is the scale for the months. On B D describe the semicircle, B K D, and divide it into six equal parts at H, I, K, L, M, and draw the lines, H *h*, I *i*, K *k*, L *l*, M *m*, perpendicular to B D. These points are the centres of the arcs for the signs of the zodiac. With centres, B and D, and distances, B 12 and D 12, describe the arcs 12 and ♑, Capricorn, and 12 and ♋, Cancer, to denote the two tropics. With centres, *h* and *m*, describe arcs passing through 12, and the one will be the arc of the signs ♒, Aquarius and ♐, Sagittarius; and the other, the arc of the signs ♊, Gemini and ♌, Leo. With centres, *i* and *l*, describe arcs passing through 12, and the one will be the arc of the signs ♓, Pisces and ♏, Scorpio; and the other the arc of the signs ♍, Virgo and ♉, Taurus. With centre, *k*, describe an arc passing through 12, for the signs ♈, Aries and ♎, Libra. With centre, 12, describe the arc, O P Q, terminated in O and Q, in the lines, 12 B and 12 D; and divide P O and P Q, each into 23½ equal parts; then the arc, O P Q, is the scale of the sun's declination.

Find the sun's declination for every fifth day in the year from a table, and, placing a ruler over the point, 12, and the degree for each day on the scale, O P Q, mark the point where the ruler meets, B D; and, at the points of division for the days of each month, write the name of that month (see fig. 2); but observe, that the days from the 21st of March to the 23rd of September, must lie on the left of *k*, which is the middle point of the scale. Cut a slit through the card along the line, B D, and put a thread through the slit, having a bead sliding along it, and a plummet at one end, which hang along the face of the dial when held vertically; and make a knot on the other end of the thread, at the back of the dial, so that it may not be drawn through the slit. Draw a line, N *v*, parallel to 12 C A, and at one end of it cut slits along *v x*, *x y*, and *y z*, three sides of a rectangle, through the card, so as to admit of its turning about the remaining side, *v z*, as a hinge. This rectangle is the gnomon of the dial, and the line, N *v*, is the shadow line.

The method of placing the hours conveniently upon the hour lines, and of forming the scale of months, will be easily understood, by inspecting fig. 2, which exhibits the dial completed.

To rectify the dial, set the thread in the slit right against the day of the month, and stretch it over the angular point, where the circles meet at XII; then shift the bead to that point of the thread, and the dial is rectified.

To find the hour of the day, raise the gnomon either more or less, and hold the edge of the dial next to the gnomon, towards the sun, so that the uppermost edge of the shadow of the gnomon may just cover the shadow line; and the bead, then moving freely on the face of the dial by the weight of the plummet, will show the time of the day among the hour lines, according as it is forenoon or afternoon. It may be observed, that the dial will indicate the hour but imperfectly, when it is near noon; but this defect cannot be properly avoided in an altitude dial.

To find the Time of Sunrise and Sunset.—Rectify the dial for the given day; move the thread among the hour lines, until it either covers some of them, or lies parallel between any two, and it will cut the time of sunrise among the forenoon hours, or the time of sunset among the afternoon hours.

To find the Sun's Declination.—Stretch the thread from the day of the month over the angular point at XII, and it will indicate the declination on the graduated arc.

To find on what Days the Sun enters the Signs.—When the bead, as above rectified, moves along any of the curve lines which have the signs of the zodiac marked upon them, the sun enters those signs on the days pointed out by the thread in the scale of months. E. L.

DYNAMICAL GEOLOGY.

(Continued from page 187.)

TORRENTS.

One example will be sufficient to show the effects of torrents, and, for that purpose, I have chosen the Falls of Niagara. It is calculated that, by the sap and fall of the hard limestone rock over which the river of Niagara is precipitated into a softer shale formation beneath,* the cataract retrogrades towards Lake Erie at the rate of fifty yards in forty years. The distance already travelled by it from the lower opening of the narrow gorge it has evidently cut by this process, is seven miles, and the remaining distance to be performed before it reaches Lake Erie, is twenty-five.†

FLOODS.

As I have already touched upon this subject, allusion now need only be made to the mighty changes occasioned by a flood of a large river, such as the Mississippi. "The earth is everywhere covered by a deep deposit of muddy loam, which, in drying, splits into deep and narrow chasms, presenting a reticulate appearance. The banks of the river are almost everywhere broken down in greater or less degree, and, in many places, several acres have been removed at a time, thickly covered with wood, and precipitated into the stream. Large streams are now found to exist where none were formerly to be seen, having forced their way in direct lines from the upper part of the bends. One of these has diverted the river from its natural course, and has shortened it by fifty miles. The upper parts of the islands present a bulwark, consisting of an enormous mass of floated trees of all kinds which have lodged there. Large sand banks have been completely removed by the impetuous whirls of the waters, and have been deposited in other places."—*Edinburgh Review.*

* The limestone overhangs the shale forty feet or more.

† Lyell's "Geology;" also Mr. Bakewell, jun., "On the Falls of Niagara," in Loudon's "Magazine of Natural History." 12.

LAKES.

Occasionally, lakes burst the barriers which enclose them; and when they do so, they commit enormous ravages, tearing down rocks, eradicating trees, destroying buildings, and overwhelming and desolating the fields. In the year 1810, in the State of Vermont, by the washing away of an under-bed of sand, the barrier of a lake suddenly burst, making an opening a quarter of a mile wide and 150 feet deep, through which the whole contents of the lake, a mile and a half long, three-fourths of a mile wide, and from 100 to 150 feet deep, were emptied in a few minutes. The liberated water rushed down a declivity to a lower lake, excavating a channel of a quarter of a mile in width, and from fifty to eighty feet deep. The accumulated torrent swept away the retaining mound of the lower lake in a moment, and, following the course of the insignificant stream which flowed out of the lower lake, rushed along a rapid descent of five miles, and then strewed its spoils over a flat country. Through all the descent, it hollowed out for itself a path from 300 to 600 feet in width, and from twenty to sixty feet in depth; so that every trace of the original bed of the river disappeared.*

To compare great things with small, those who remember the bursting of a vat, some years ago, in Meux's brewery, may form some notion of the catastrophe derived even from a very small natural accumulation of water breaking suddenly upon the neighbouring territories.

THE SEA.

While the mountains, valleys, and plains of the interior of a country, are undergoing slow, but perpetual, change, by the combined efforts of atmospheric agency and of running water, the coasts and shores are exposed to destruction from the action of the waves of the sea.

Almost the whole of the eastern and southern shores of Britain exhibit traces of the power of the sea on islands, promontories, bays, and estuaries; on bold lofty cliffs, as well as on low sands; and on every description of rock and soil, from granite to blown sand. A few examples will suffice to give the reader an idea of the power exercised.

An inn at Sherringham, on the Norfolk coast, built, in 1805, seventy yards from the sea, in 1829 was separated only by a small garden from the edge of the cliff.

* The Rev. S. Dwight, in "Silliman's Journal" for June, 1826.

There is now a depth of water sufficient to float a frigate at one point in the harbour of that place, where, only half a-century ago, there stood a cliff fifty feet high, with houses upon it. The whole site of ancient Cromer now forms a part of the German Ocean. The church of Reculver, on the coast of Kent, was nearly a mile inland in the reign of Henry VIII.; it is now little more than sixty yards from the water's edge. The old town of Brighton, which stood between the site of the present cliff and the sea, in the reign of Elizabeth, has been wholly destroyed. The Island of Heligoland, off the entrance of the River Elbe, has been reduced to the fourth part of its size in the last 500 years, and, since 1770, has been divided into two parts, the channel between them being navigable by large ships. There is every reason to believe, that the Island of Ceylon was, at one time, united to the Continent of Hindostan. Humboldt is of opinion, that the Caribbean was once a mediterranean sea, enclosed by a circuit of land, of which the Caribbee Islands, St. Domingo, Jamaica, and Cuba, are the remains.

Thus the whole effect of drainage, including all the preliminary influences of the atmosphere, rain, springs, &c., is to waste the high ground and to raise the low; to smooth the original ruggedness of the valley in which it flows, by removing prominences and filling up hollows. A consideration of this circumstance brings forcibly to the mind the Pythagorean saying, *Nihil est toto quod perstet in orbe.*

ON THE NATURE AND ADVANTAGES OF FLY-WHEELS.

A FLY, in mechanics, is a heavy wheel or cylinder, which moves rapidly upon its axis, and is applied to machines for the purpose of rendering uniform a desultory or reciprocating motion, arising either from the nature of the machinery, from an inequality of the resistance to be overcome, or from an irregular application of the impelling power. When the first mover is inanimate—as wind, water, and steam—an inequality of force obviously arises from a variation in the velocity of the wind, from an increase or decrease of water occasioned by sudden rains, or from an augmentation or diminution of the steam in the boiler, produced by a variation in the heat of the furnace; and, accordingly, various methods have been adopted for regulating the action of these variable powers. The same inequality of force obtains, when machines are moved by horses or men. Every animal exerts its greatest strength when first set to work. After pulling for some time, its strength will be impaired; and, when the resistance is great, it will take frequent, though short, relaxations, and then commence its labour with renovated vigour. These intervals of rest and vigorous exertion, must always produce a variation in the velocity of the machine, which ought particularly to be avoided, as being detrimental to the communicating parts, as well as the performance of the machine, and injurious to the animal which is employed to draw it. But if a fly, consisting either of cross bars, or a massy circular rim, be connected with the machinery, all these inconveniences will be removed. As every fly-wheel must revolve with great rapidity, the momentum of its circumference must be very considerable, and will, consequently, resist every attempt either to accelerate or retard its motion. When the machine, therefore, has been put in motion, the fly-wheel will be whirling with a uniform celerity, and with a force capable of continuing that celerity, when there is any relaxation in the impelling power. After a short rest, the animal renews his efforts; but the machine is now moving with its former velocity, and these fresh efforts will have a tendency to increase that velocity. The fly, however, now acts as a resisting power, receives the greatest part of the superfluous motion, and causes the machinery to preserve its original celerity. In this way the fly secures to the engine a uniform motion, whether the animal takes occasional relaxations or exerts his force with redoubled ardour.

We have already observed, that a desultory or variable motion frequently arises from the inequality of the resistance, or work to be performed. This is particularly manifest in thrashing mills, on a small scale, which are driven by water. When the corn is laid unequally on the feeding-board, so that too much is taken in by the fluted rollers, this increase of resistance instantly affects the machinery, and communicates a desultory or irregular motion even to the water-wheel or first mover. This variation in the velocity of the impelling power, may be distinctly perceived by the ear in a calm evening, when the machine is at work. The best method of correcting these irregularities, is to employ a fly-wheel, which will regulate the motion of the machine when the resistance is either augmented or diminished. In machines built upon a large scale, there is no necessity for the

interposition of a fly; as the *inertia* of the machinery supplies its place, and resists every change of motion that may be generated by an unequal admission of the corn.

A variation in the velocity of engines arises, also, from the nature of the machinery. Let us suppose that a weight of 1000 lbs. is to be raised from the bottom of a well fifty feet, by means of a bucket attached to an iron chain, which winds round a barrel or cylinder, and that every foot length of this chain weighs 2 lbs. It is evident, that the resistance to be overcome in the first moment is 1000 lbs. added to 50 lbs., the weight of this chain, and that this resistance diminishes gradually as the chain coils round the cylinder, till it is only 1000 lbs., when the chain is completely wound up. The resistance, therefore, decreases from 1050 lbs. to 1000 lbs.; and if the impelling power be inanimate, the velocity of the bucket will gradually increase; but if an animal be employed, it will generally proportion its action to the resisting load, and must, therefore, pull with a greater or less force, according as the bucket is near the bottom or top of the well. In this case, however, the assistance of a fly may be dispensed with, because the resistance diminishes uniformly, and may be rendered constant by making the barrel conical; so that the chain may wind upon the part nearest the vertex at the commencement of the motion, the diameter of the barrel gradually increasing as the weight diminishes. In this way the variable resistance will be equalized much better than by the application of a fly-wheel; for the fly, having no motion of its own, must necessarily waste the impelling power.

When machinery is driven by a single-stroke steam-engine, there is such an inequality in the impelling power, that for two or three seconds it does not act at all. During this interval of inactivity, the machinery would necessarily stop, were it not impelled by a massy fly-wheel of a great diameter, revolving with rapidity, till the moving power again resumes its energy.

If the moving power be a man acting with a handle or winch, it is subject to great inequalities. The greatest force is exerted when the man pulls the handle upwards from the height of his knee, and he acts with the least force when the handle, being in a vertical position, is thrust from him in a horizontal direction. The force is again increased when the handle is pushed downwards by the man's weight, and it is diminished when the handle, being at its lowest point, is pulled towards him horizontally. But when a fly is properly connected with the machinery, these irregular exertions are equalized, the velocity becomes uniform, and the load is raised with an equable and steady motion.

In many cases, where the impelling force is alternately augmented and diminished, the performance of the machine may be increased, by rendering the resistance unequal, and accommodating it to the inequalities of the moving power. Dr. Robinson observes, that "there are some beautiful specimens of this kind of adjustment in the mechanism of animal bodies."

Besides the utility of fly-wheels, as regulators of machinery, they have been employed for accumulating or collecting of power. If motion be communicated to a fly-wheel by means of a small force, and if this force be continued till the wheel has acquired a great velocity, such a quantity of motion will be accumulated in its circumference, as to overcome resistances, and produce effects which could never have been accomplished by the original force. So great is this accumulation of power, that a force equivalent to 20 lbs., applied for the space of thirty-seven seconds to the circumference of a cylinder twenty feet diameter, which weighs 4713 pounds, would, at the distance of one foot from the centre, give an impulse to a musket-ball equal to what it receives from a full charge of gunpowder. In the space of six minutes and ten seconds, the same effect would be produced, if the cylinder were driven by a man who constantly exerted a force of 20 lbs. at a winch one foot long.

This accumulation of power is finely exemplified in the sling. When the thong, which contains the stone, is swung round the head of the slinger, the force of the hand is continually accumulating in the revolving stone, till it is discharged with a degree of rapidity which it could never have received from the force of the hand alone. When a stone is projected from the hand itself, there is even then a certain degree of force accumulated, though the stone only moves through the arc of a circle. If we fix the stone in an opening at the extremity of a piece of wood two feet long, and discharge it in the usual way, there will be more force accumulated than with the hand alone; for the stone describes a larger arc in the same time, and must, therefore, be projected with greater force.

When coins or medals are struck, a very considerable accumulation of power is necessary, and this is effected by means

of a fly. The force is first accumulated in weights fixed in the end of the fly. This force is communicated to two levers, by which it is farther condensed; and from these levers it is transmitted to a screw, by which it suffers a second condensation. The stamp is then impressed on the coin or medal by means of this force, which was first accumulated by the fly, and afterwards augmented by the intervention of two mechanical powers.

Notwithstanding the great advantage of fly-wheels, both as regulators of machines and collectors of power, their utility wholly depends upon the position which is assigned them, relative to the impelled and working points of the engine. For this purpose, no particular rules can be laid down, as their positions depend altogether on the nature of the machinery. We may observe, however, in general, that, when fly-wheels are employed to regulate machinery, they should be near the impelling power; and, when used to accumulate force in the working point, they should not be far distant from it. In hand-mills for grinding corn, the fly is, for the most part, very injudiciously fixed on the axis to which the winch is attached; whereas it should always be fastened to the upper millstone, so as to revolve with the same rapidity. In the first position, indeed, it must equalize the varying efforts of the power which moves the winch; but when it is attached to the turning millstone, it not only does this, but contributes very effectually to the grinding of the corn.

ON THE ORIGIN OF THE APPLICATION OF STEAM TO NAVIGATION.

(From the "Nautical Magazine.")

The discovery of the steam-engine constitutes, unquestionably, one of the most splendid triumphs of modern science; whether we consider the magnitude of the power itself, so far beyond anything which, prior to this invention, had ever been contrived, or even conceived, of mechanical agency; the inventive talent by which the principle was originally brought to light; or the amazing ingenuity and skill which has given it practical effect in its infinitely diversified application to arts, manufactures, and the general business of life. It is impossible to contemplate, without a feeling of exultation, this wonder of modern art; this prodigiously powerful agent, which sets in motion machinery of the most stupendous energy; which raises the most enormous masses of water from the lowest depths of our mines, and moulds into form, as if by magical facility, the hardest and most intractable materials; while it can be, at the same time, regulated and adapted to operations of the extremest nicety and minuteness. We see the same agency setting in motion the loom, and propelling the vessel on the ocean—the sea and the land thus teeming with the fruits of this marvellous invention, and bearing testimony to its usefulness and power.

Of all the uses to which the power of steam has ever been applied, that of locomotion is the most important; promoting, as it does, that facility of intercourse between the most distant points of a country, which, of all improvements, most essentially conduces to its prosperity; which, binding its different parts more firmly together, increases its strength, and gives it greater consistency and unity of action; and which, if this were the proper place to enlarge on such a subject, it would be easy to show, must even extend its beneficial influence to many of the great moral interests of an intelligent and highly refined community. It is in this view that we consider the application of the steam-engine to this great object, as replete with such important consequences. It is now nearly twenty years since the agency of steam was applied to navigation, and every one is acquainted with the new and wonderful facilities which this discovery has opened up for the trade and intercourse of the country, and with the remarkable changes which it has actually effected, wherever any communication by sea, river, or canal, has permitted it to extend its influence. From the earliest times, mankind have been baffled by the uncertain elements of the winds and waves: by these a barrier was raised to the progress of navigation, which the boasted improvements of modern times were never able to overcome; and the proverbial uncertainty of a sea-voyage continued, accordingly, to be ranked among the irremediable evils of life. Hence it was, that, when a voyage of a few miles might be protracted to several days, those great rivers and inlets of the sea which penetrate far into the land, instead of being of unrivalled utility to commerce, formed rather a drawback, in many cases, on our internal communications; while, with respect to rivers, no attempt could be made, with the least advantage, to navigate them against the stream. We possessed no power which could accomplish this object. The use of a river, as

an instrument of internal intercourse, was, in consequence, much limited ; and no craft were ever found to ply on any of the great streams, because they could only make their way in one direction. They were useless, except for this single purpose ; and, in all countries, the water communications were, in a manner, mutilated and imperfect.

As an example of the difficulties of internal navigation, it may be mentioned that, on the great river Mississippi, which flows at the rate of five or six miles an hour, it was the practice of a certain class of boatmen, who brought down the produce of the interior to New Orleans, to break up their boats, sell the timber, and afterwards return home slowly by land; and a voyage up the river from New Orleans to Pittsburgh, a distance of about 2000 miles, could hardly be accomplished, with the most laborious efforts, within a period of four months. But the uncertain and limited influence, both of the wind and tide, is now superseded by a new agent, which, in power, far surpassing the raging torrent, is yet perfecly manageable, and acts with equal efficacy in any direction. The practical effects of this great discovery have been truly astonishing. Coasting voyages, which were formerly tedious and uncertain, can now be performed with all the expedition of land journeys. The most rapid rivers, on which only a solitary boat was here and there placed for the convenience of crossing, have now become the active scenes of intercourse and trade ; they are covered with large vessels, crowded with passengers on pleasure or on business, which, by the powerful aid of steam, resist the current, and force their way with ease through the opposing waters. Steamboats of every description, and on the most improved models, ply on all the great rivers of the United States ; the voyage from New Orleans to Pittsburgh, which formerly occupied four months, is accomplished, with ease, in fifteen or twenty days. On the rivers, lakes, inlets, as well as the narrow seas of Europe, they are everywhere to be seen ; and in the interior navigation of our own country, they have already superseded the use of all other vessels. The intercourse of Great Britain with Ireland, as well as with France, where the two countries are contiguous, is also chiefly carried on by these conveyances ; on the western shores of Scotland, which are intersected through their whole extent by a series of deep inlets, or lochs, as they are termed, the advantages of steam navigation have been wonderfully exemplified, and a complete change has, in consequence, been effected in the aspect of the country, and in the habits and intercourse of the people.

William Symington, the father of modern steam navigation, was a native of Leadhills, county of Lanark, Scotland. While receiving an education to qualify him for the Church, an early predilection for mechanical philosophy led him to abandon his theological studies, and pursue, with ardour, those connected with his favourite science. His genius soon attracted the notice and secured the patronage of Gilbert Meason, Esq., then connected with the Wanlock Head lead-mines. Before completing his twenty-first year, Mr. Symington had made several improvements on the steam-engine ; and, having protected them by his majesty's royal letters patent, constructed and introduced engines on his principle into different parts of England and Scotland.

As early as the year 1784, amidst the wild bleak scenery of the country he inhabited, and when he knew nothing of any attempts which might have been made to realize such an idea, it occurred to him that steam might be rendered available for the propulsion of locomotive carriages. He immediately set about embodying his idea ; and, in 1786, submitted to the inspection of the professors and other scientific gentlemen in Edinburgh, a working model of a steam-carriage, which afforded such proofs of capability, that he was warmly urged by all present to carry his invention into full effect.

But with a sense of honour which redounds to his credit, he would not allow his friendly advisers, or his patron, Mr. Meason, to embark in an undertaking to which the state of the roads in Scotland, and the difficulty of procuring fuel and water, presented, in his opinion, insurmountable objections. Besides, he was the more easily induced to abandon his experiments on land-carriage, by a belief in the possibility of more advantageously employing steam for the purposes of navigation.

While the model was in Edinburgh, Patrick Miller, Esq., of Dalswinton, who had heard of it from Mr. James Taylor, tutor in his family, who had been a schoolfellow of Mr. Symington, called at Mr. Meason's, and, having minutely inspected it, expressed himself highly pleased with its construction and performance. In the course of conversation, Mr. Miller mentioned that he had spent much time in making experiments for the propelling of vessels upon water by

wheels in place of sails or oars; and that they had been put in motion by applying manual strength to turning a handle or winch. He also said he had attempted to work them by the power of horses, as he had heard something of the same kind had been accomplished, even by means of oxen, in America. It occurred to Mr. Symington, and he stated his opinion to Mr. Miller, that a steam-engine might be constructed which would propel a vessel, by communicating a rotary motion to the paddles, by the alternate action of two ratchet wheels, in the same manner as in the model of the steam-carriage, then before them. Mr. Miller said he considered such a thing impracticable; and inquired how it could be possible to work such an engine on board, without setting the vessel on fire?

The description given of the model, and the manner in which it was intended to apply the power of steam, seemed to convince Mr. Miller of the practicability of the project; and he observed, that, if Mr. Symington thought he could construct a steam-engine, and work it with safety on board of a vessel, an experiment should be made, on a small scale, as soon as he could possibly attend to it: and it was explicitly understood that the plan and construction of the engine, the mode of producing rotary motion, and the means to be adopted for guarding against danger, were to be left entirely to Mr. Symington.

Soon after this conversation, by Mr. Miller's desire, he proceeded to construct a small engine, on a similar principle to one for which he had previously procured a patent. It was executed under his immediate inspection, and fitted on board a small double-keeled vessel, lying upon a lake, near the house of Dalswinton. With this vessel a trial was made of the powers of the invention, in the autumn of 1788, in presence of Mr. Miller, and various persons of respectability; when the boat was propelled in so satisfactory a manner, that it was immediately determined to commence another experiment, upon a more extended scale.

In the month of October, 1789, a second exemplification was afforded on the Forth and Clyde inland navigation, in presence of hundreds of spectators, who lined the banks of the canal, to witness what seemed so extraordinary an attempt; and who testified, by acclamation, their satisfaction at its result. The boat glided along, propelled at the rate of nearly six miles an hour; and all parties interested declared their conviction of the success of the experiment.

In this instance, the machinery was constructed at the Carron Works, also, under the sole direction of Mr. Symington, and erected in a boat which had been used in Mr. Miller's previous experiments.

Having thus established the correctness of his views, Mr. Symington had the misfortune to lose the patronage of Mr. Miller, who suddenly withdrew himself from public business, and devoted his time to improving Dalswinton estate. Under these circumstances, Mr. Symington's pecuniary resources being insufficient to enable him, unaided, to go farther in endeavouring to introduce steam navigation, he was compelled to desist, and turn his attention to the fulfilment of engagements with the Wanlock Head Company, for constructing machinery on a large scale, to enable them more extensively to carry on their operations.

After an interval of ten years, the late Thomas Lord Dundas, of Kerse, applied to Mr. Symington, and, having alluded to his former experiments, expressed a wish that he would employ himself in constructing a vessel capable of being propelled by the power of steam, and superseding the use of horses in dragging vessels upon the Forth and Clyde Canal; of which canal his lordship was an extensive proprietor. Accordingly, under the auspices of that intelligent nobleman, a series of experiments was commenced in January, 1801, and continued until April, 1803. The cost of these experiments somewhat exceeded 7000*l.*; but they placed beyond the possibility of doubt, the practicability of steam navigation.

In March, 1802, Mr. Symington took on board the *Charlotte Dundas*, Lord Dundas, the Hon. Captain George Dundas, R. N., Archibald Spiers, Esq., of Elderslee, and several gentlemen of their acquaintance; and with two laden vessels, each of seventy tons burden, attached to the steam-boat, performed with great ease the voyage to Port Dundas, Glasgow, a distance of nineteen miles and a half; although it blew so strong a gale right a-head, during the whole course of the day, that no other vessel in the canal attempted to move to windward.

Having afforded so complete a verification of what he had ventured to predict he would accomplish, a proposal was made to the proprietors of the canal, to substitute steam-boats as tugs in lieu of horses; but it was rejected, on the allegation, that the undulation created in the water by means of the paddle-wheels,

would have the effect of washing down the banks, and thereby do greater injury than any benefit likely to be conferred by the invention could counterbalance; and although, on this point, Lord Dundas and Mr. Symington were of a different opinion, they felt themselves compelled to abandon almost all hope of carrying in that place the invention farther into effect, against a host of opponents, steeped in prejudice, and filled with preconceived opinions.

(To be continued.)

HISTORY OF MEDALS.

(Continued from page 221.)

Mr. Pinkerton next proceeds to give an account of the mixed metals used among the Romans. In Britain, all kinds of coins made of mixed metal are, without hesitation, alleged to be forgeries; although it is certain, that the variety of mixed metals used in coinage was very considerable. The most valuable mixture was that of gold and silver, already mentioned, named electrum; the silver commonly amounting to one-fifth part of the gold made use of, or perhaps more. Of this mixture are many of the early coins of Lydia, and some other Asiatic states; also those of the kings of the Bosphorus Cimmerius, during the imperial ages of Rome. Next to the electrum were the coins of Corinthian brass; but Mr. Pinkerton informs us, that not a single coin was ever struck of this metal by the ancients; it having been constantly employed only in the fabrication of vases or toys. It was in use, at any rate, only for a very short time; being altogether unknown in the days of Pliny the Elder. Our author, therefore, ridicules those who pretend not only to find out imperial coins of this metal, but to discover three kinds of it—viz. one in which the gold predominates, another in which the silver prevails, and a third where the brass is most conspicuous. He gives Æneas Vico, one of the most ancient writers on medals, as the author of this idea, but whose opinions were confuted by one Savot, a writer in the seventeenth century. Vico mentions a coin of this kind struck under Augustus, another of Livia, and a third of Claudius. The mistake, he is of opinion, arose from the circumstance of the first propagator not being able to account for the various mixtures and modifications of brass observable in ancient coins of the large size; and which, in so common a metal, appear very odd to the moderns. Besides the authority of Pliny and other antiquaries of a more modern date, who all declare that they never saw a single medal of Corinthian brass, or of that metal mixed with silver and gold, our author adduces another evidence, which he looks upon to be superior to either—viz. that those who have given into this supposition, imagine, that the large pieces called *sestertii*, and others *dupondiarii*, worth about twopence or a penny, are said to have been composed of this precious metal. It is unreasonable to think, that any proportion of gold or silver could have been made use of in these. The coins said to have been struck upon Corinthian brass, are only done upon a modification of common brass; of which we know, that in proportion to the quantity of zinc made use of in conjunction with the copper, the metal assumes a variety of hues. On the authority of Pliny he informs us, that the coins mistaken for Corinthian brass, were no other than prince's metal.

The Egyptian silver coins struck under the Roman emperors are, at first, of tolerably pure silver, but afterwards degenerate into a mixture of copper and tin, with a little silver. They are very thick, but many of them are elegantly struck, with uncommon reverses. There are, likewise, three sets of brass coins belonging to this country, from the earliest times of the Roman emperors there. Some of these are of bell-metal or pot-metal; and after the time of Gallienus and Valerian, the coinage of brass with a small addition of silver, becomes authorised by the state; the coins struck upon it being called *denarii ærei.* Those of lead or copper, plated with silver, have been fabricated by Roman forgers. Some coins of lead, however, have been met with of undoubted antiquity; and an ancient writer informs us, that tin money was coined by Dionysius, but none has been found. The lead coins of Tigranes, King of Armenia, mentioned as genuine by Jobert, are accounted forgeries by Mr. Pinkerton and other modern medallists. Plautus, however, makes mention of leaden coins, and several of them have been found; but our author looks upon them to have been chiefly essay pieces, struck in order to let the artist judge of the progress of the die. Others are the plated kind, already mentioned, fabricated by ancient forgers, but having the plating worn off. A great number of leaden coins are mentioned by Fricorini, in a work entitled "Piombi Antichi," in which he supposes them to have served as tickets for guests; and coins of the same kind are also mentioned by Pas-

seri. In the work entitled "Notitia Imperii Romani," there is mention of coins made of leather, but none of them have ever been found.

In considering the different sizes, values, &c., of the Greek and Roman coins, our author treats of the medals as money; a knowledge of which, he says, is essentially necessary to every reader of the classics; insomuch, that it may almost dispute the preference with the studies of ancient geography and chronology. Notwithstanding all that has been written upon the subject, however, our author is of opinion, that the science is still in its infancy, in as far as it relates to the real money of the ancients. "The ideal," says he, "which is, indeed, the most important province of discussion, has been pretty clearly ascertained; and we are almost as well acquainted with the Attic *mna* or *mina*, and the perplexing progress of the Roman sertertia, as with our own pounds. But with the actual coin of the ancients, the case is different; and the ignorance even of the learned, in this point, is wonderful."

Our author now goes on with great asperity of language, to particularize the ignorant manner in which modern authors have treated the subject of medals. "Arbuthnot and Clarke," says he, "are, if possible, more ignorant of medals than Budæus, the very first. The latter professes his love of medals, but quotes a consular coin with the head of Cicero; and looks upon one of the thirty pieces of silver, the reward of the treachery of Judas, and which was said to be preserved among some relics at Paris, to be worthy of reference and commemoration. Arbuthnot, if we may judge from his book, had never seen any ancient coins; and Clarke, it is well known, was quite ignorant of them. The latter, with all his labour, seems even to have known nothing of the theoretic part of the real ancient money. Indeed Dr. Mead's catalogue seems to have been almost the only book on medals which had undergone his perusal. On the other hand, the ignorance of medallists on this score is no less profound. To this day they look upon the didrachms of Ægina, so celebrated in antiquity, as tridrachms of Ægium; and upon the early obolus as a brass coin. In the Roman class, the large brass is esteemed the *as*, while it shall be proved that it is the sestertius, and worth four *ases*. The denarius is reckoned at ten ases, even in the imperial times; whereas it only went at that rate for the first ninety years after the coinage of silver at Rome. The denarius ærens is taken for silver currency; with other mistakes, which evince that medallists are as ignorant of the theory, as the others are of the practice."

In his account of the ancient Greek money, Mr. Pinkerton observes, that the light of science, like that of the sun, has proceeded from east to west. "It is most probable," says he, "that the first invention of money arose like the other arts and sciences; and spread from thence into the western parts of the world. In its first shape it appeared as mere pieces of metal, without any stated form or impression; in lieu of which, it was regulated by weight. Even down to the Saxon government in England, large sums were regulated by weight; and, in our own times, every single piece is weighed in gold; though, with regard to silver, this nicety is not minded, nor, indeed, does it seem practicable. Among the ancients, whose commercial transactions were less important and extensive than those of the moderns, silver was weighed as well as gold; nay, even brass in some cases."

In Greece, large sums were determined by *mnæ* or *minæ;* and the most capital sums by *talents.* In every country, the mina is supposed to have contained 100 drachmæ, or small silver coins, of that country, and the talent sixty minæ. The mina is supposed to be a pound weight of the country to which it belonged. The Attic pound, according to Dr. Arbuthnot contained sixteen ounces, equal to our avoirdupois pound; but Mr. Pinkerton looks upon this as a very absurd opinion, and accuses the doctor of having adopted it, merely that he may explain a passage in Livy. He is of opinion, that the Attic pound is very nearly the same with the pound Troy. The mina of Athens had, at first, seventy-three drachms; but by Solon it was fixed at 100. The ancient drachm weighed the same which it does at present in medical weight—viz. the eighth part of an ounce. The mina or pound of twelve ounces, had, consequently, ninety-six of these drachms; but four of them were given to the round sum, to supply defects in the alloy; "and, indeed," says our author, "in consequence of a common practice in all ages and in all countries, of giving some addition to a large weight. Thus the pound in weight had, in fact, but ninety-six drachmæ, while the pound in tale had 100; as the Roman libra, in weight, had but eighty-four denarii, in tale 108; and as our pound in tale, by an inverse progress, is not a third of our pound in common weight."

Notwithstanding the very severe criti-

cism on Dr. Arbuthnot just mentioned, however, we find our author adopting his account of the talents used in coinage in several countries. Thus, according to the doctor, the

	Attic Minæ.
Syrian talent had	15
Ptolemaic	20
Antiochian	60
Eubœan	60
Babylonian	70
Larger Attic	80
Tyrian	80
Egyptian	80
Æginean	100
Rhodian	100

TEETH OF WHEELS.

To the Editor of the Penny Mechanic and Chemist.

Sir,—It appears to me, from the letter of your correspondent, who terms himself a "Journeyman Millwright," that he is not in want of the information that he apparently solicits; if he be, I shall be happy to supply him with it. I hope he will excuse my negligence; but indisposition has prevented me replying earlier. Would he be kind enough to state on what authority his "young master" informed him, that teeth of a similar construction had been previously introduced.

I remain yours, &c.,

T. R. Bilbrough.

BLUE ON STEEL.

To the Editor of the Penny Mechanic and Chemist.

Sir,—With every respect for your correspondent, "Mr. Taylor," I beg to inform him that it is comparatively useless for me to make any farther assertion respecting oxygen being the cause of the blue on steel; as "Mr. Taylor" states, that oxygen is not contained in steel. Does "Mr. Taylor" suppose, that, in the conversion of iron into steel, the carbon (charcoal) attracts the whole of the oxygen from the iron, forming carbonic acid? If it does, I admit the correctness of "Mr. Taylor's" argument; but, as he has not advanced any proof of the correctness of his theory (any farther than steel being a compound of iron with carbon), it is, in my humble opinion, useless for me to confute his statement.

I remain yours, &c.,

T. R. Bilbrough.

PADDLE-WHEELS.

To the Editor of the Penny Mechanic and Chemist.

Sir,—In the perusal of the back Numbers of your invaluable Magazine, I have seen several figures of boats propelled with paddle-wheels in water. Now it requires considerable power to turn paddle-wheels in water; as there is a great weight of water to lift on the back part of the wheel in going round, and the more so the deeper they are, which, of course, greatly retards the forward motion of the vessel. I have a contrivance for propelling boats and other vessels, by which I think this drawback would be avoided; consequently, there would be great power saved. Can you or any of your correspondents inform me, through the medium of your little work, of any person that would act honourably, if I made the invention known to him?

I remain yours, &c.,

T. F.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Allow me to return my sincere thanks to your correspondent, "Mr. F. Baker," for his kind intentions towards elucidating the subject; but I beg to inform him, that, if he would peruse my former papers, he would perceive the cause of his surprise. Any of the acids that have affinity for oxygen, would have caused the like results.

I remain yours, &c.,

T. R. Bilbrough.

THE CHEMIST.

POTASSA.

It has long been a desideratum with chemists, to possess a method of preparing potash in a state of absolute purity; the strong tendency which it has to combination, renders this extremely difficult. The following are the methods now made use of:—

1. Bouillon la Grange's apparatus consists of several boxes of common deal. At the bottom put river sand, which must be well washed, and over it add another stratum, but of a finer kind, and cover the whole with a cloth, besprinkled with wood-ashes. In the bottom of each box a hole is made, into which is fitted a glass tube, for the purpose of affording a passage to the liquor, as it filters through the sand.

Having arranged the apparatus in this manner, take equal parts of quicklime and potash of commerce, if the lime be very caustic; but, in the contrary case, it requires twenty parts of lime to fifteen of potash. Put water into an iron kettle, bring it nearly to a state of ebullition, and then add lime, which, by its slaking, will bring the water to that state completely. When it is slaked, mix the potash, and form of the whole a thick liquid, which must be suffered to cool a little. Then pour the mixture into the boxes, and immediately throw water over it; but, to prevent the water from making holes, when added, place over it a small board, which will rise with the water.

Care must be taken to place earthen pans, or other vessels, to receive the liquor which runs through the tubes; and, that the ley may not absorb carbonic acid from the atmosphere, the vessels must be closed with care, in such a manner as to exclude the external air. It will be necessary, also, to keep water always over the mixture, which must be collected till it passes tasteless from the tubes.

The liquors obtained are nearly of the same degree of strength, till towards the end of the process; when they grow weak suddenly.

To evaporate the water, use should be made of cast-iron pots, beginning with the last portions, which are a little weaker; and, to prevent the necessity of keeping the strongest a long time in contact with the air when boiling, a strong ebullition is requisite. When the fluid is concentrated to a certain degree, any sulphate of potash that may be present will crystallize, and be precipitated.

To obtain dry potash, pour the concentrated liquor into a small basin, and proceed with the evaporation, till a little of it, poured on an iron plate or a marble slab, becomes solid.

Then put the concrete potash into a jar, and pour over it very strong alcohol; the potash alone dissolves in it; the sulphate and muriate of potash, with the portions of earth and even of carbonic acid, which it obstinately retains, or which it may have acquired from the air during the evaporation, remain at the bottom of the solution. Afterwards decant the pure liquor, and distil it in a retort till it becomes colourless. It must then be evaporated in a silver basin. On cooling, it crystallizes in white laminæ, which are sometimes three-tenths of an inch in length; or, instead of suffering it to crystallize, it may be evaporated to dryness.

2. Lowitz has given another method. According to this chemist, the whole of the operation for obtaining potash of the greatest purity, and without the least colour, consists in this:—A lixivium of potash, freed from carbonic acid in the usual manner, is evaporated to a thick pellicle. After the cooling, the foreign salt, which has crystallized, is to be separated, and the evaporation of the lixivium continued in an iron pot. During this second evaporation, the pellicle of foreign salts, particularly of carbonate of potash, which continues to be formed, must be carefully taken off with an iron skimmer. When no more pellicle is formed, and the matter ceases to boil up, it is removed from the fire, and suffered to cool, continually stirred with an iron spatula. It is then to be dissolved in double the quantity of cold water, and the solution filtered and evaporated in a glass retort, till it begins to deposit regular crystals. If the mass should consolidate ever so little by cooling, a small quantity of water is to be added, and it must be heated again to render it fluid. After the formation of a sufficient quantity of regular crystals, the fluid, which is very brown, is to be decanted, and the salt, after being suffered to drain, must be redissolved in the same quantity of water. The decanted fluid must be kept in a well-closed bottle, and suffered to become clear by subsiding during several days. It must then be decanted for a second evaporation and crystallization. The process must be repeated as long as the crystals afford, with the least possible quantity of water, solutions perfectly limpid. These solutions are to be preserved in well-closed bottles, to defend them from the access of air.

The greatest difficulty of this process arises from the facility with which the fluid assumes a solid form. To obviate this inconvenience, a small portion of it may be concentrated to the point at which it becomes converted into a solid mass by cooling. The saturation of a lixivium, considerably evaporated, may be ascertained, by throwing small pieces of this mass into it during its cooling. When these are no longer dissolved, it is a proof that it is at the required point.

With regard to the foreign salts which are mixed with the potash, the greatest portion separates by crystallization, after the first evaporation. The rest is separated during the second concentration, by the continual skimming of the pellicle. The little which may remain with the potash, must precipitate for want of water of solution, in a lixivium, wherein the al-

kali itself is no longer dissolved, but by its own water of crystallization.

The property of alkalies to dissolve in highly rectified alcohol, with the exclusion of every foreign salt, would afford an excellent means of obtaining potash very pure, if their mutual action did not afford a new source of impurity. For when an alkali, absolutely pure and crystallized, is dissolved in spirits of wine, even without heat, the fluid assumes a very brown colour, which becomes still deeper, after being decanted from the saline mass.

The crystallization of potash is very different, accordingly as the crystals are formed with cold or heat. In the first case, the crystals obtained are octahedra in groups, which contain 0.43 water of crystallization, and excite, by their solution in water, even in the summer, a degree of cold very near the point of aqueous congelation. In the second case, very thin crystalline transparent blades, of extraordinary magnitude, are formed, which, by an assemblage of lines crossing each other in infinite directions, present an aggregate of cells or cavities, most commonly so perfectly closed, that the vessel may be inverted without the escape of the smallest drop of lixivium, though sometimes included to the amount of an ounce or two. For this reason, it is necessary to break this fine crystallization, that the fluid may run off. The crystals present, in their regular formation, rectangular tetragonal blades, which, as they contain little water of crystallization, produce a considerable degree of heat when dissolved in water.

By exposing such alkaline crystals to a red heat, in a silver crucible, they become fused; and, after cooling, afford a mass as white as snow, extremely caustic and deliquescent.

As the crystals and the lixivium, during the length of time required to drain the salt, may frequently become charged with a portion of carbonic acid, it is advisable, in order to avoid this inconvenience as much as possible, that the lixivium, as soon as it is brought to the requisite point of concentration, should be poured into a narrow-necked bottle, and well closed therein, to crystallize. After the crystals are formed, the bottle is to be reversed without opening, and kept in a temperature rather warm, until the crystals are well dried. During the winter the liquor, after the first crystallization, continues to crystallize without being submitted to a new evaporation, provided only that it be exposed to a temperature somewhat colder than that wherein the first crystals were formed.

Properties of Pure Potash.—Potash, in a crystallized form, consists of soft, quadrangular, compressed prisms, which are extremely caustic and deliquescent. It dissolves all soft animal matters, when brought into contact with it. It liquifies by a gentle heat, and rises in fumes at high temperatures. It does not unite in a direct manner with phosphorus. It easily combines with sulphur and metallic oxides. It dissolves alumine in the humid way, and even a small quantity of silex; but it does not act on glucine or zircon, nor on magnesia or lime. It contracts no union with barytes. It absorbs water and carbonic acid rapidly. It fuses into glass with silex, by the aid of fire. It combines with the acids, and forms salts, which, in general, do not yield their acid, unless to barytes. It changes blue vegetable colours green, and possesses all the general properties of alkalies.

Decomposition of Potassa.—Potassa, from its analogy to ammonia, has often been conjectured to be a compound body; but nothing satisfactory had ever been proved. Its decomposition, however, has since been effected by the labours of Mr. Davy, and the discovery of its constituents, will ever be regarded as the most important in chemistry. Mr. Davy was led to institute experiments, with a view to decompose the fixed alkalies, by his previous discovery, that, by the powers of galvanism, the principles of bodies were separated, according to a certain law; some being attracted to the one galvanic pole, others to the other; and that the strength of these attracting forces is proportional to the energies of the opposite electricities in the galvanic circle, and to the conducting power and the degree of concentration of the substances submitted to their action.

(To be continued.)

MISCELLANEA.

THE COAL-MINE CRUELTIES.

Money-worship has its rites, and we question whether any form of idolatry which this world of ours has witnessed, has been equally grinding in its exactions. Englishmen have been wont to exhibit a laudable indignation whenever and wherever political despotism has perpetrated wanton cruelty. We do not blame them; but, possibly, were due examination made, we might discover, under our very feet, and within a stone's throw of many of us, a social despotism, whose deeds of barbar-

ity, if they may be paralleled, cannot be surpassed. "The love of money," we learn from high authority, "is the root of all evil." And, assuredly, the money-Moloch of our country, and of this age, is about the grimmest, fiercest, and most implacable god which ever claimed and had the fealty of men. We turn up our eyes with wonder at the besotted votaries who, in days gone by, "made their children pass through the fire." The votaries of Mammon in this enlightened and Christian country, are not a whit behind their ancient fellow-worshippers. Our factories are daily scenes, even now, of hecatombs of youthful victims, sacrificed, not only without remorse, but with a stoical indifference, to which it is difficult, we should imagine, for human nature, in its most depraved state, to attain. But our mines—the infernal cruelty practised upon boys and girls in these graves both of comfort and virtue, has never, in any age, been outdone. The recent disclosures made in the Parliamentary Report of the "Children's Employment Commission," may well excite the horror of every individual in whom a vestige of humanity remains. We have sometimes read, with shuddering disgust, of the outrages committed upon helpless childhood by man, when existing in a state of naked savageness. We aver our belief, that, in cold-blooded atrocity, they do not equal what is going on from day to day in some of our coal mines. Young creatures, both male and female—six, seven, eight, and nine years old, stark naked in some cases, chained like brutes to coal-carriages, and dragging them on all-fours, through sludge six or seven inches deep, in total darkness, for ten, occasionally twenty, in special instances thirty, hours successively, without any other cessation, even to get meals, than is casually afforded by the unreadiness of the miners—here is a pretty picture of British civilization. One cannot read through the evidence taken by the Commission above referred to, without being strongly tempted to abjure the very name of Englishman. Wealth, it is true, covereth a multitude of sins. But we do think, that were the names, in every instance, of the proprietors of mines, who persist in thus setting at nought the laws of nature and humanity (religion is out of the question in such a connexion), kept prominently before the public eye, there is sufficient virtue still extant among us, to consign these Mammon-worshippers to execration and infamy. Amongst the various mysteries of Providence, certainly not the least—in our judgment one of the greatest—is the permission to such monsters, to profit by worse than brutal cruelty to children—and, perhaps, in no country under heaven does avarice doom the tender offspring of the poor to more terrible privations, to more incessant suffering, than in our own. What may prove an effectual remedy to the evil, we know not; but we think the professedly religious portion of the community is under obligation to hunt down the beast in human form, who coins his gold out of the suffering and demoralization of childhood, let him pass by what name, and move in what sphere, he will. Society ought to hiss him out of sight.—*Nonconformist.*

Heat endured by Vertebrated Animals.—Delaroche and Berger placed several species of vertebrated animals in a temperature varying from 108° to 113°, when most of them remained quiet at first; but, after the lapse of half-an-hour, they became restless and hurried. The result showed that vertebrated animals, in a dry air, heated to 113°, are near the utmost limit of temperature in which they can exist. After recovering the effects of this heat, they were removed to an atmosphere of from 134° to 144°, when, except one frog, they all died, between 24 minutes and 2 hours. A young man remained 20 minutes in an oven, heated to 210° Fahrenheit. Berger and Blagden exceeded this, the former enduring 230° during 7 minutes, and the latter from 240° to 260°, 8 minutes. Delaroche could not remain more than 10 minutes in a vapour-bath, at 100°. Berger was obliged to get out of a vapour-bath at a temperature of 122° in 12½ minutes. The sensation in hot vapour resembles that of contact with boiling water. Blagden and others, in heated rooms, at 289°, experienced no inconvenience in respiration, and the heat of their bodies did not rise above 99½°. Chabert entered an oven at 500°; but all metal acquired the full heat; water boiled, &c. Fish, too, actually live in hot baths up to 158°. Trees also grow in a bath at 174°; flowers, near a volcano, at 210°; and water-plants are found in boiling springs.

Discovery of an Ancient Sword.—At a sale which took place in the neighbourhood of Whetstone a short time since, a gentleman had knocked down to him a lot which contained, among a number of other articles, a very rusty old sword without a sheath, apparently of little or no value. It exhibited such a rusty, miserable appearance, that the sons of Israel present began immediately to ridicule the

purchaser on his fortunate prize; inquiring whose it was, and what sum was asked for it. One of them (to keep up the joke) offered the owner the extraordinary sum of 7*s*., which he would most willingly have accepted, had it not been for fear of being laughed at, so little did he value it at the moment. He was led, however, shortly afterwards, to have it cleaned, in order to ascertain whether it was worth anything or not, when, to his great astonishment, notwithstanding the contempt shown for it by the Jew brokers, it proved to be a most magnificent specimen of the kind of sword worn by noblemen in the middle ages. The hilt is of solid gold, beautifully encircled by a curbed silver chain, which winds round the handle from top to bottom in a spiral form, and is bordered by a very minute chain of fine gold. Everything connected with this part of the weapon displays the most exquisite workmanship; the pommel and the guard being composed of the most elaborate devices (trophies, escocheons, &c.), on fine steel, inlaid with silver. The blade of this curious relic of antiquity is 33½ inches in length, fluted, like the ordinary dress swords, but surprisingly broad and strong near the hilt, which is seven inches long. It appears, that this superb piece of *vertû* has lain unnoticed, in a room among a quantity of old furniture, for nearly a century and a half, having been found in a field, near Hadley Wood, by one of the servants, in the early part of the last century. The polishing it has undergone lately, has restored it to such an excellent condition, that several criteria exist to afford some idea of the time it was made, and the artist's name, as the pommel is surrounded on the top by the Collar of the Garter, and two other parts bear the thistle and what appears to be the artificer's peculiar mark—a trefoil flower, with the numbers two and four. There are two other facts that may tend to throw some farther light on the history of this curious weapon—viz. the celebrated engagement between the houses of York and Lancaster took place very near the spot on which it was discovered; and Enfield Chase, where King James I. and most of the monarchs since his time have hunted, is close to it also. It is at present in the possession of a gentleman at Hadley, named Brouillet, who has very kindly consented to show it to any amateur or antiquarian, who might feel desirous of seeing so interesting a specimen of the art and magnificence of former times.—*Times.*

Exportation of Machinery.—Never at any time, since the bobbing-lace machinery was first exported by John Clutts, in 1816, were lace-machines taken out of the kingdom in greater quantities, than during last month; as, from the best information we can obtain, no less than thirty-four warp and bobbin machines have been taken out of this district within that period, one person having taken, we are assured, no less than eight to Lille. So boldly has this trade been carried on, that machines were openly packed at a neighbouring village, and taken to a wharf in open day. By a decision of the Court of Exchequer, although these machines may be seen thus packed, and the parties should declare they were going to France or Germany, they may be taken by river or canal to London, and declared not water-borne, according to the statute, until they are put on board a vessel or boat on the Thames, with the intent to be shipped. Thus, if the Excise or Customs seize them on the canal or on a London wharf, they are too soon; and, if they watch to see them on board, the ship is soon under sail, and then they are too late, the packages being entered as other goods. Such is the manner in which the manufacturing interest, or, rather, the productive interest, has been latterly protected.—*Nottingham Journal.*

Caution to Amateur Artists.—A young man, who had received from an amateur phrenologist a very encouraging account of his development, resolved to have a cast taken of his face, and those parts of the head where the intellectual faculties are said to lodge. This is a rather delicate operation, requiring great skill and dexterity on the part of the practitioner. The plaster of Paris is applied in a state of solution, and, as it dries with the greatest rapidity, the artist requires to adopt precautions to prevent the plaster from adhering so firmly to the skin, as to render the separation difficult. As to the person operated upon, he can do nothing to aid himself; his only anxiety is to escape suffocation. Well, the youth in question placed himself in a recumbent position, demanding and receiving an assurance that nothing would be done to deprive his lungs of the necessary supply of atmospheric air. Quills were placed in the nostrils to secure the means of breathing, and his features having been placed in a state of repose, the artist proceeded to apply his solution. On it went in a stream; but, most unfortunately, when the time came to separate the face from its covering, the substances refused to part. Here was a business! The artist lost his self-command—the young man

got alarmed and ran home. His friends, of course, were duly frightened, for they had no means of recognising their child but by his clothes: the neighbours were called in, and hot water and many other things were applied to the stucco, but yield it would not. At last a mason suggested that a chisel and hammer should be tried. This was accordingly done, and, after much labour, the face was hewn out. —*Gloucester Chronicle.*

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, June 29, J. S. Buckingham, Esq., on American. Friday, July 1, R. Adams, Esq., on Acoustics. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, June 30, Mr. Traice, on the Spirit of Comedy as displayed in the Dramatic Productions from the Restoration to the Middle of the last Century. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, June 27, Quarterly Meeting. At a quarter-past eight o'clock.

QUERIES.

I shall feel much obliged to any of your correspondents, if they can inform me of a method of hardening tallow by a cheap process? Pressure would be too expensive. Sulphuric acid mixed with it, when warm, does it in a small degree, but not sufficiently. A. F.

I have lately constructed a seraphine which, for beauty and quality of tone, far exceeded my expectations, and at a very trifling cost. Could I keep it in tune, everything would be done to my desire. This, I suppose, is owing to the reeds or tongues being of brass, instead of some other metal. I have tried hammered, rolled, and pressed brass, but none of these will keep long in tune together. A friend of mine, who has also constructed one, is in the same dilemma; and he is now trying steel, and, as far as he has gone, it appears to answer. I wish some one of your able correspondents to inform us, through the medium of your excellent publication, what kind of metal is the best, and where it can be procured. J. W.

ANSWERS TO QUERIES.

"H. T. L." can purchase a full account of the Daguerreotype process, with plates and instructions, at Waller's, 188, Fleet Street.

"T. Jones" is rather obscure in his definition of what he requires. Possibly a weight might answer his purpose. He should state whether he requires the bellows to be moveable or fixed; if the latter, a small windmill might, perhaps, do.

"H. Cowley." The brownish-red powder is precipitated when the solution of sulphate of copper is too weak; the lumps of copper, when the solution is of sufficient strength, but the action of the battery too great. Possibly also, he may not cover the seals, &c., equally with the plumbago. The paper prepared with bichromate of potash, cannot be made sensitive enough for use by the camera obscura. Potassium can be obtained at Dymond's, Holborn Bars, or Potter's, in Holborn, at about 4*d.* per grain. Photographic is the term usually applied to the Daguerreotype drawings; photogenic, to those done on paper, according to Mr. Fox Talbot's method.

If "T. F. B." will look back to No. 57, he will find his query answered among the answers to correspondents. G. S., Jun.

"G. S, Jun.," is in error, when he says that the twelfth stop in an organ is a third below the fifteenth; it should be a fourth below, or a fifth above, the principal. I am confident, too, that he is wrong, when he says that old type metal is the best composition for metal pipes: it is too brittle. When the cone came to be inserted for the purpose of tuning them, the pipes would crack, as any printer will tell him. Having been many years engaged in the use of this metal, I am quite certain, without the addition of some other to soften it, it will not answer. I believe the composition used by organ builders is a mixture of tin and tea-lead. J. Ward.

TO CORRESPONDENTS.

W. Alpress *wishes to know whether the respirator invented by Mr. Jeffery, and which is now becoming very general in its application, is really injurious to the lungs or not, as medical men appear to differ in their opinions on the subject. It is rather a difficult task to decide, when doctors disagree; but as the respirator possesses the property of rendering the air inhaled warm, however cold or dense a fog—effected by the air passing through several layers of particularly fine gold or silver wire—we cannot see how any injury can result from its use.*

A Constant Subscriber.—*If his communication had reached us, it would certainly have been replied to. We can have no recollection of it, as so many of our friends sign "A Constant Subscriber." To such as do, we usually reply with the initials "A. C. S.," which may, perhaps, be the cause of our correspondent not perceiving any answer to his inquiry. We would recommend him to use the initials of his own name.*

We believe the cheapest place to purchase chemical apparatus, is at Palmer's, 103, Newgate Street, where he may know the price of the auro and argento cyanuret of potassium. He can obtain the first three volumes of the Penny Mechanic *at Berger's, Holywell Street, unbound, and most likely at a reduced price.*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.
A MAGAZINE OF THE ARTS AND SCIENCES.

No. **90**, THIRD SERIES. | SATURDAY, JULY 2, 1842. | No. 338, OLD SERIES.

ROTARY STEAM-ENGINE.

Vol. VIII.—No. 31.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ROTARY STEAM-ENGINE.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—Having tried several experiments on the screw, I send you the above plan for a rotary steam-engine; considering steam may be used in this way with great advantage, the friction being so much reduced by the above plan. If you think it worth notice, and it is not intruding too much on your valuable work, I shall feel obliged by your inserting it.

R. Hammond.

Description of the Engraving.

A A A A, the outer cylinder; B, the screw inside the cylinder, which revolves; C C, the axis; D D, the stuffing boxes; the steam enters the cylinder at E, and makes its escape at F, whereby a rotary motion is obtained.

ON THE ORIGIN OF THE APPLICATION OF STEAM TO NAVIGATION.

(*Continued from page* 233.)

Lord Dundas was so convinced of the efficiency of Mr. Symington's exemplification, that he requested a complete model of the steam-engine and boat (with a set of ice-breakers attached) should be made. This was done, and Mr. Symington proceeded to London, and presented it to his lordship, at his residence in Arlington Street. Lord Dundas, after examining it, suggested the propriety of its being submitted to the inspection of his Grace the Duke of Bridgewater, whom his lordship knew to be an enterprising and enlightened nobleman; who, if he approved of the invention, could adopt it upon the extensive canals of which he was the sole proprietor.

His lordship accordingly called upon the duke, and, having mentioned that Mr. Symington was in town, requested he might be permitted to wait upon his grace, for the purpose of exhibiting the miniature exemplification of his invention, and explaining its powers. In reply to this request, his grace observed, that it appeared to him altogether needless to amuse themselves farther with anything regarding steam-boats, as he could well assure his lordship, they would never be made to answer any useful purpose; having himself—subsequently to the experiments which Mr. Symington had made in Scotland—bestowed upon the subject much pains and great expense, without having attained the least hope of success; yet, with this impression as to the improbability of its utility, he was still willing to see anything new, and consented to examine the model.

When Mr. Symington called next day, after exhibiting his boat and explaining its construction and capability, his grace's sentiments underwent so complete a change, that he declared such a vessel as the one before him, had every appearance of answering the purpose he wished; and, pointing to his collection of paintings, which, he said, had cost him upwards of 100,000*l*., stated his belief that the advantage which trade might, at some future period, derive from the use of such steam-boats, would many times exceed the value of his excellent gallery of pictures. To show his conviction of the truth of this prediction, he gave Mr. Symington an immediate order to build eight boats of a similar construction, for the use of his canal; and pressingly requested him to devote his whole time to its execution, with the least possible delay.

Mr. Symington returned to Scotland, elated with the prospect of being able, in a short time, successfully to introduce steam navigation, and to realize to himself and family advantages which his ingenuity and unwearied perseverance gave him so just a title to anticipate; but, as if doomed to disappointment, the day which saw him satisfactorily complete his last experiment, witnessed the downfal of his expectations. For on that very day he was informed by Lord Dundas, of the committee's final determination not to allow steam-boats to be employed on the canal; and also of the death of the Duke of Bridgewater.

Unable longer to struggle against such a multitude of misfortunes, Mr. Symington—his own resources being exhausted—was obliged, with great reluctance, to lay up his boat in a creek of the canal, near to Bainsford Drawbridge, where it remained for many years, exposed to the view of the public.

During the time the boat lay at Bainsford, Henry Bell, of Glasgow, was frequently beheld inspecting it; and, in 1811, he, in conjunction with others, constructed the *Comet* steam-boat, which, in that year, first plied upon the Clyde.

With regard to Bell, it can be indisputably proved, that he had numerous opportunities of witnessing the whole of Mr. Symington's exemplifications, from their commencement to their termination; and

that he was at the Carron Works, where he was often seen inspecting the machinery, even while it was being manufactured. Indeed, to such an extent did he carry his curiosity, that the workmen used to complain to Mr. Symington of being unable to keep him out of the place where they were making the patterns. Reference to the books of the Carron Company will prove the circumstance of his having been present.

Much praise has been awarded to Bell for the introduction of steam navigation; but how far he deserves it, the following facts will elucidate:—Notwithstanding the many opportunities he had enjoyed—notwithstanding his having voyaged to America, to instruct, or to be instructed by, the celebrated Fulton—the *Comet* was far inferior in her performance, even to Mr. Symington's second exemplification. When the *Comet* commenced her operations as a passage-boat upon the Clyde, she possessed four insignificant paddle-wheels, and took nine hours to sail from Port Glasgow to Glasgow.

The *Elizabeth* steam-boat was the next constructed. Bell hinted his intention to prevent her being built; but his pretensions were too well known to induce the followers of his piracy to pay any attention to his threats; and he soon had the mortification to see numerous and far more elegant vessels deprive him of the advantage at which his lawless cupidity had tempted him to grasp.

When it is known that Mr. Symington mentions, in his specification, that the wheels may be placed in the centre, or at the sides of the vessel, according as circumstances may require, where, in reference to such construction and adaptation, are the superior skill and talent, of an honest kind, displayed by Bell, as an inventer?

(To be continued.)

THE NEW PATENT COMPOSING MACHINE.

Hitherto, in spite of some abortive experiments, the compositor branch of the printing business has been deemed secure from the operation of machinery in diminishing the demand for manual labour. This security is now, we suspect, at an end; for we think that no practical printer can examine the new patent "Composing Machine"— now at work, and exhibiting at 110, Chancery Lane—without being satisfied that it will lead to a greater change in the compositor department, than the steam-press has done in the branch technically called press-work.

Although the public are generally tolerably familiar with the art and mystery of putting types together, we would require to begin in some sort *ab initio*, in order to render a verbal description intelligible: not that the machine itself is complicated; it combines, in its construction, beauty, precision, and simplicity. Any compositor may understand its action in ten minutes, may work it after an hour's practice, and should be able to do so with facility in a day. But let us remind the general reader of what is the business of a compositor.

A compositor, in "setting up," as it is called, stands at a frame that supports his cases, which contain the type, each letter having its separate box or compartment. Holding the composing-stick in his left hand, he picks up the types with the thumb and fore-finger of the right, conveying them, with a rapid motion, to the composing-stick, which is adjusted to the exact breadth of the particular work he is engaged on. Each line must be *justified*—that is, extended to the full breadth and rendered tight—which is effected by placing more or less spaces between the words, and by dividing words, when an entire word cannot be introduced at the end of a line. When the composing-stick is full, the mass is lifted out—an operation of some dexterity—and placed on a galley, the compositor refilling his "stick" as before.

The labour of putting type together, does not require much of absolute muscular exertion, but it requires great activity, considerable dexterity and facility of hand, with no small portion of endurance. A clever compositor will put together as many as 2000 types in an hour. In this calculation, the spaces which divide words are included; for though, of course, they do not appear in print, they must be picked up by the compositor, as well as the letters.

Now, the new "composing machine" enables two individuals, with the subsidiary aid of two or three boys, to put as many types together in an hour, as can be done by four clever compositors, and that, too, without a tithe of the physical power required by the present mode of composition. Hence, two boys, or two intelligent girls, may perform the work of four men; and the type, by this process, is put together in a continuous series, without the necessity of dividing the copy, as it is called—a necessity which frequently causes inconvenience when work is in a hurry,

by reason of one man having his portion of copy done before another.

The "composing machine" is a patented invention, by Messrs. Young and Delcambre, who have now triumphed over former obstacles, and produced a felicitous contrivance. On entering the room where the machine is at work (110, Chancery Lane), the visiter perceives what one of our contemporaries has termed "something of the appearance, viewed in front, of the interior of a cottage piano." At the instrument sits a young lady, the copy before her, precisely in the attitude of one about to charm a drawing-room. Suppose she is about to compose the words *Morning Chronicle*, she touches the key which communicates with the channel holding the letter M, and immediately the letter flies down an inclined plane, through an open serpentine channel cut in a brass plate. The other letters follow, and the complete words are propelled by a wheel, along a brass slide, towards the person who justifies—that is, whose business it is to divide the continuous stream of metal words into lines of the requisite length. For this purpose the justifier is provided with a box divided into compartments, containing spaces of different thicknesses, with hyphens, the marks indicating divided words. But we do not know that we can better describe the instrument, than by quoting a portion of a description already given to the public:—

"The machine itself has something of the appearance, viewed in front, of the interior of a cottage piano, and has seventy-two keys, precisely of the shape of the keys of that instrument. To these keys are attached upright steel rods, which communicate with the same number of brass channels at the top of the machine. These channels contain a complete font of type, each channel having its proper letter. At the back of the machine is an inclined plane, with thirty-six curved channels, all of equal length, into which the letters are made to fall, and through which they proceed to a sort of spout, down which they are gently forced, by an ingenious eccentric movement, towards the person who justifies.

"The key, when struck, moves a small lever, which, as it were, cuts off a letter from the column in the brass channel. The lever instantaneously resumes its former position, and the column of letter, by its own weight, as instantaneously descends, the bottom letter being ready for the lever to let it out immediately it is required; and so on till the whole column of that particular letter may be exhausted. The letter, falling into the curved channel on the inclined plane at the back of the machine, descends into the spout before spoken of. This spout is very little wider than the type which falls into it, letter by letter, with its face towards the person playing the machine. This spout is curved downwards, from its mouth, for ten or twelve inches, and, when the machine commences work, is filled with quadrats the whole length of such curve, as a support for the letters to fall on. The eccentric movement alluded to, touches the letters above one-third up as they fall into the spout, and gently forces them through the curve, and thence along a horizontal channel of brass towards the justifying-box. Here the type is drawn into what the compositor would call a stick; and, when the proper number of lines have been justified, they are taken out and placed in a galley, precisely as the composing-stick is emptied. Any process more simple to effect such a purpose, it would seem impossible to accomplish."

The person playing the machine must possess the ordinary intelligence necessary for composing; and the type, thus composed, is as liable to be filled with blunders as by the present mode of composition. The player may omit to touch a key—may mis-spell a word—may omit a sentence; or, if the copy be manuscript, commit some of those mistakes which occasionally inflict "agony of agonies" on the souls of sensitive authors. But the facility with which the *modus operandi* may be acquired, is evinced by the circumstance, that the machine is worked by young women, with the assistance of boys, who are thus occupied:—The young women are alternately, for two hours each, employed in playing the machine, in justifying, and correcting. Two of the boys are engaged in filling the seventy-two channels with their respective letters, two in distributing the type, and the fifth boy in giving motion to the wheel, by which the type is pushed forwards into and along the spout, towards the justifying line. The work done, at present, is, at least, equal to that which could be accomplished by four able compositors, at about a third of the expense, while the machine occupies no more space than a piano. The maker of the machine is Mr. J. G. Wilson, of 10, Perceval Street, Clerkenwell. Its expense is about 100*l*., and the one now in operation was made in about five weeks.

ON THE FIRST MOVERS OF MACHINERY.

The powers which are generally employed as the first movers of machines, are water, wind, steam, and animal exertion. It appears from observation, than an ordinary man can, for the space of ten hours, turn a winch with a force of 30 lbs., and with a velocity of two feet and a half per second; and that two men working at a windlass, with handles at right angles to each other, can raise 70 lbs. more easily than one man can raise 30 lbs. The reason of this is, that, when there is only one man, he exerts variable efforts at different positions of the handle, and, therefore, the motion of the windlass is irregular; whereas, in the case of two men, with handles at right angles, the effect of the one man is greatest when the effect of the other is least, and, therefore, the motion of the machine is more uniform, and will perform more work. It has also been found, that a man may exert a force of 80 lbs. with a fly, when the motion is pretty quick, and that, by means of a good common pump, he may raise a hogshead of water ten feet high in a minute, and continue the exertion during a whole day.

A variety of interesting experiments upon the force of men, were made by the learned M. Coulomb. He found, that the quantity of action of a man who ascended stairs with nothing but his own weight, was double that of a man loaded with 223 lbs. avoirdupois, both of them continuing the exertion for a day. In this case, the total or absolute effect of the unloaded man is the greatest possible; but the useful effect which he produces is nothing. In the same way, if he were loaded to such a degree that he was almost incapable of moving, the useful effect would be nothing. Hence there is a certain load with which the man will produce the greatest useful effect. This load M. Coulomb found to be 173.8 lbs. avoirdupois, upon the supposition that the man is to ascend stairs, and continue the exertion during a whole day. When thus loaded, the quantity of action exerted by the labourer, is equivalent to 183.66 lbs. avoirdupois raised through 3282 feet. This method of working is, however, attended with a loss of three-fourths of the total action of the workman. It appears, from Coulomb's experiments, that a man, going up stairs for a day, raises 205 chiliogrammes (each equal to three ounces, five drachms avoirdupois) to the height of a chiliometre (equal to 39,571 English inches); that a man, carrying wood up stairs, raises, together with his own weight, 109 chiliogrammes to one chiliometre; that a man, weighing 150 lbs. French, can ascend, by stairs, three feet (French) in a second, for the space of fifteen or twenty seconds; that a man, cultivating the ground, performs nineteen-twentieths as much labour as a man ascending stairs, and that his quantity of action is equal to 328 lbs. avoirdupois, raised through the space of 3282 feet; that a man with a winch does six-eighths as much as by ascending stairs; and that, in a pile-engine, a man, by means of a rope drawn horizontally, raised, for the space of five hours, 55⅓ lbs. French, through one foot French in a second. When men walk on a horizontal road, Coulomb found, that the quantity of action was a maximum when they were loaded, and that this maximum quantity of action is to that which is exerted by a man loaded with 190.25 lbs. avoirdupois, as 7 to 4. The weight which a man ought to carry, in order that the useful effect may be a maximum, is 165.3 lbs. avoirdupois. When the workman, however, returns unloaded for a new burden, he must carry 200.7 lbs. avoirdupois.

According to Desaguliers and Smeaton, the power of one horse is equal to the power of five men. Several French authors suppose a horse equal to seven men, while M. Schulze considers one horse as equivalent to fourteen men. Two horses, according to the experiment of Amontons, exerted a force of 150 lbs. French, when yoked in a plough. According to Desaguliers, a horse is capable of drawing, with a force of 200 lbs., two miles and a half an hour, and of continuing this action eight hours in a day. When the force is 240 lbs., he can work only six hours. It appears from Smeaton's Reports, that, by means of pumps, a horse can raise 250 hogsheads of water, ten feet high in an hour. The most disadvantageous way of employing the power of a horse, is to make him carry a load up an inclined plane; for it was observed by De la Hire, that three men, with 100 lbs. each, will go faster up the inclined plane, than a horse with 300 lbs. When the horse walks on a good road, and is loaded with about 200 cwt., he may easily travel twenty-five miles in the space of seven or eight hours.

When a horse is employed in raising coals by means of a wheel and axle, and moves at the rate of about two miles an hour, Mr. Fenwick found that he could continue at work twelve hours each day, two and a half of which were spent in

short intervals of rest, when he raised a load of 1000 lbs. avoirdupois, with a velocity of thirteen feet per minute; and that he will exert a force of 75 lbs. for nine hours and a half, when moving with the same velocity. Mr. Fenwick also found, that 230 ale gallons of water, delivered every minute on an overshot water-wheel, ten feet in diameter; that a common steam-engine, with a cylinder eight inches in diameter, and an improved engine, with a cylinder 6.12 inches in diameter, will do the work of one horse—that is, will raise a weight of 1000 lbs. avoirdupois, through the height of thirteen feet in a minute. It appears from Mr. Smeaton's experiments, that Dutch sails, in their common position, with a radius of nine feet and a half—that Dutch sails, in their best position, with a radius of eight feet, and that his enlarged sails, with a radius of seven feet, perform the same work as one man; or perform one-fifth part of the work of a horse.

HISTORY OF MEDALS.

(Continued from page 235.)

NOTWITHSTANDING the concession made by Mr. Pinkerton to the Doctor, he tells us, that he very much questions the list of talents, and that many ancient writers are little to be relied upon. "Writers on this subject confess, that the numbers in all ancient manuscripts are the parts most subject to error, as being almost always contracted. They ought to allow, that the authors themselves must often be liable to wrong information."

Coinage, according to Herodotus, was first invented by the Lydians, from whom the Greeks quickly received it. The former could not have received it from the Persians, whose empire did not begin till 570 B. C., though our author supposes that it might have proceeded from the Syrians, who carried on commerce in very ancient times. The most ancient Greek coins of silver have an indented mark upon one side, and a tortoise upon the other; and those of the greatest antiquity have no letters upon them. Those of later date have AIΓI marked upon them, which medallists interpret of Ægium, in Achaia; being led into that supposition by the tortoise, which they look upon as a sure mark of the Peloponnesus. But though our author agrees that the tortoise was so, he thinks that they are otherwise very far wrong in their conclusions. Ægium, in Achaia, was a place of no consequence till the times of Aratus and the Achæan league; but there are eleven of these coins in Dr. Hunter's cabinet, which show that they must have been struck in times of the most remote antiquity, and that the place where they were struck, was rich and flourishing at the time. The coins we speak of are not common; but those which have the name AIΓEIΩN at full length, and which may, perhaps, belong to Ægium, in Achaia, are extremely scarce; insomuch, that in all Dr. Hunter's vast collection, there are not above one or two. They are, likewise, constructed upon a scale quite different from all other Grecian money; being of 8, 13, 15½, 90, and about 186 grains. The Grecian drachma, at an average, is sixty-six grains; and Mr. Pinkerton thinks it would have been strange if pieces had been struck of eight-tenths of an obolus and a half, or of a drachma and a half. Ægium, being originally an obscure village, could not be the first which coined money: so that Mr. Pinkerton supposes the name AIΓI to have stood for Ægialus, the ancient name of Sicyon, a wealthy and powerful city; or, rather, Ægina, the mint of which was much celebrated, and, perhaps, the most ancient in Greece.

Other arguments in favour of these coins being derived from Ægina, are drawn from their weight as well as their workmanship, which are quite different from those bearing the name of Ægium at full length. The coinage of Ægina is known to have been different from that of the rest of Greece; insomuch, that its drachma was worth ten Attic oboli, while the Attic drachma was valued only at six. Hence the drachmas of Ægina were named by the Greeks παχειαν, or *thick*; a name very applicable to the coins in question. From these observations, our author is of opinion, that we may even distinguish the precise weight of the ancient coins of Ægina. According to the exact proportion, the drachma of this place should weigh 100 grains; and one of them, very much rubbed, weighed above ninety. The others of larger size, which seem to be didrachms of Ægina, weigh from 181 to 194 grains; but the latter being the only one he could meet with in good preservation, it was impossible to form any just medium. Even in those best preserved, he thinks, that ten grains may be allowed for a waste of the metal in so long a time as 2400 years, which would bring the drachma of Ægina near its proper standard. The obolus of Ægina was in proportion to its drachma of six oboli. It is the piece of fifteen grains and a half, and thirteen when very much rubbed. The hemiobolon is that of eight, but, when rubbed, it falls short of this weight.

The general denomination of the Greek money is the drachma, or eighth part of an ounce, which to this day is retained in the medical weights, the Grecian coins receiving the names they bore from their weights; though, in some instances, the weights received their appellations from the coins. The silver drachma, according to Mr. Pinkerton, was about ninepence sterling; and he finds fault with those who make the drachma and denarius both equal to one another, the latter being no more than eightpence. The didrachm of silver, according to the same calculation, was worth eighteenpence; but the tridrachm occurs very rarely; and Mr. Pinkerton is even of opinion, that medallists give this name to the didrachm of Ægina. The largest of all the Grecian coins is the tetradrachm, which, on the Æginean standard, is worth five shillings; but in those of the other states only four. There are, however, many subdivisions in the silver drachma; the highest being the tetraobolion or coin of four oboli; being in proportion to the drachma as our groat to a sixpence, weighing about forty-four grains, and being in value about sixpence. The hemidrachm or triobolion comes next in value, weighing about thirty-three grains, and worth fourpence halfpenny. The silver diobolion, or third of the drachma, weighs about twenty-two grains, and is worth threepence. The obolus of silver weighs about eleven grains, and is worth only three halfpence. There is, likewise, a hemiobolion in silver, or half the obolus, of five grains and a half, value three farthings; and another tetraobolion dichalcos or quarter obolus, which is the most minute coin yet met with; and, by reason of its extreme smallness, weighing only two grains and a quarter, is now very scarce: but there is one in the cabinet of Dr. Hunter, and some more have been lately brought from Athens by Mr. Stuart. Some of them are, likewise, met with at Tarentum. It would appear, however, that there were some still smaller, and of value only three-fourths of a farthing. None of these have been met with; and the smallness of the size renders it improbable that any will ever be met with; as the peasants, who commonly discover coins, would probably either not observe them at all, or, if they did, would neglect them as things of no value.

(To be continued.)

Lead melts at 594° by itself, bismuth at 460°, and tin at 408° of Fahrenheit; yet, if mixed in the proportions of 5, 8, and 3, they melt at 200°. —*Phillips.*

LONDON ELECTRICAL SOCIETY.

At a meeting of this Society on June 21, a paper was read "On Native Malleable Copper," by John A. Phillips, Esq.; the object of which communication was illustrated by mineralogical specimens, and was to show that natural electrotype deposits are constantly being found in the veins and fissures of rocks; and the opinions of authors go very far towards commanding conviction. Indeed, when we examined the specimens exhibited, we could scarcely fail to feel the force of the assertion. This paper was succeeded by one closely bearing upon, and fully illustrative of, the same, "On the Transfer of Mineral Substances through various Fluids by Electric Agency," by Andrew Crosse, Esq., M.E.S. The unceasing experimental exertions of Mr. Broomfield, philosopher, are well known. These experiments are in illustration of his conviction, that the large majority of mineral formations are the result of the direct electrical affinity of the several elementary substances which constantly come in contact in nature, and chiefly by aqueous agency. He does not at all assume the necessity of metallic nuclei, but shows that isolated minerals suffer most material changes. He alludes to the greater increase of crystals in weak than in strong solutions. He treats upon a phenomenon not elsewhere noticed, of the increase of electrolytical power, when the containing cell is porous. He next alludes to the nature of pearls, and states his opinion, that they are an electrical concretion of animal and mineral substances; he thinks that the time is not far distant, when we shall succeed in producing the gems by electric agency. His attention is still directed to the acarus, which has been frequently developed in the experiments detailed in the present communication, and hopes soon to communicate with the Society on that subject. This notice is but a mere syllabus, and an imperfect one, too, of one of the most interesting papers that have fallen beneath our notice for some time; and we are well assured, that few of our readers who take the least interest in these things, will fail to study the paper itself, which will be printed in a few days. Mr. Hick's register was then read, and the chairman having announced Mr. Halker's paper "On Lightning Conductors," for the next meeting, the Society adjourned till Tuesday, July 19.

ASTRONOMICAL PHENOMENON.

On Thursday evening, June 23, a grand phenomenon was displayed in the south-eastern part of the heavens, when the moon, which is only the fiftieth part of the size of our earth, rose about seven minutes past nine, being at that time preceded by the planet Saturn, a magnificent globe, 1000 times larger than our own, and accompanied by seven moons, in addition to its splendid rings. Jupiter, whose magnitude far exceeds all the other planets in the solar system, being 1400 times larger than the earth, followed quickly after the moon, rising in the same part of the horizon, about a quarter of an hour after that luminary. The moon attained her greatest altitude at midnight; consequently, about eleven o'clock they formed a group of the most splendid objects for the contemplation of the young astronomer, that a summer's aspect could possibly afford him. Saturn appeared near the north-western limb of the moon, and Jupiter at a greater distance to the east. A day or two after the occurrence of this phenomenon, the satellites of Jupiter and the rings of Saturn, may have been seen with a good telescope; but the best time will be during the first week in July, when they will make the nearest approach to us, being then in opposition to the sun. At that time, the distance of Jupiter will be 400,000,000, and that of Saturn 812,000,000 miles from the earth.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, July 6, J. Wonfor, Esq., on Fermentation, and the Arts of Brewing and Distilling. Friday, July 8, R. Addams, Esq., on Acoustics. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, July 7, Dr. Wilks, on Vegetable Physiology. At half-past eight.

QUERIES.

Which are the best ingredients used in colours generally, to cause them to dry in a few hours; more particularly for oil-painting? Also, is there any method to ascertain the strength of spirits of wine and turpentine, without the use of the hydrometer? B. G.

The method adopted by manufacturing chemists, for making the "sodæ bicarbonas" usually sold by druggists? H. N. B.

"A. Taylor" will much oblige me if he will inform me whether the atmospheric air is entirely excluded from a small steel spring, which I am in the habit of blueing between two plates of brass, firmly screwed on each side of the spring, for the purpose of keeping it in coil, while tempered or blued. I find that the blue colour is as regular on the top and bottom, where the two plates of brass touch the spring, by being firmly screwed, as where the air has free access to the side. J. W.

If any of the readers of the Penny Mechanic are in want of a small electrical machine, I shall be very happy to furnish them with one at a very cheap rate. The machine was made by an amateur; but I can safely say, that it is far superior to many of those of the same size sold at the philosophical instrument-makers. Any communications on this subject may be addressed to "S. A. J., care of the Editor of the Penny Mechanic," who has kindly promised to forward them.

I have thought of a plan of improvement in the steam-engine, which, if it answer my expectations, will be the saving of at least one-half the fuel and water which are used by the engine now in use. I have not time to make a model, nor am I in condition to have one made. I have only the theory, which, I think, is very good, and should be glad to know to whom I had better communicate, and how, if by letter or personally. T. P.

ANSWERS TO QUERIES.

To Bleach Shell-lac.—I beg to recommend the following process, of Mr. Henry Lunings, for bleaching shell-lac, for which he was rewarded by the Society of Arts. Dissolve five ounces of shell-lac in a quart of rectified spirits of wine; boil for a few minutes, with ten ounces of well-burnt and recently-heated animal charcoal, when a small quantity of the solution should be drawn off and filtered; if not colourless, a little more charcoal must be added. When all the colour is removed, press the liquor through silk, as linen absorbs more varnish, and afterwards filter it through blotting-paper.

The best Bronze for Brass Work.—Take 1 lb. of muriatic acid and ½ lb. of white arsenic. Put them into an earthen vessel, and then proceed in the usual manner. Delateur.

I am obliged to "J. Ward" for pointing out the error of mine, in calling the twelfth stop a third below the fifteenth; it should be a fourth below. I am not wrong, however, as he supposes, in saying, that old type-metal will do best; I have been told so repeatedly by one of the most eminent organ-builders in London. Some of them use a mixture of tea or other lead and tin, and some use type-metal and tin, as I mentioned before in one of my papers.

"J. W." His seraphine may, probably, get out of tune, from the vibrators not being fixed sufficiently tight. He will find steel produces a much superior tone to brass. I have made a seraphine with steel vibrators, and it keeps in tune extremely well, and the tone is very brilliant. Silver is the best metal to use, if he does not mind the expense. The vibrators may also be made of whalebone, instead of metal; but I do not know whether they get out of tune or not. The worst metal is German silver; for though the sound produced by it is soft and mellow at first, the metal appears to rot in some way, and the vibrators constantly require to be renewed. G. S., Jun.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

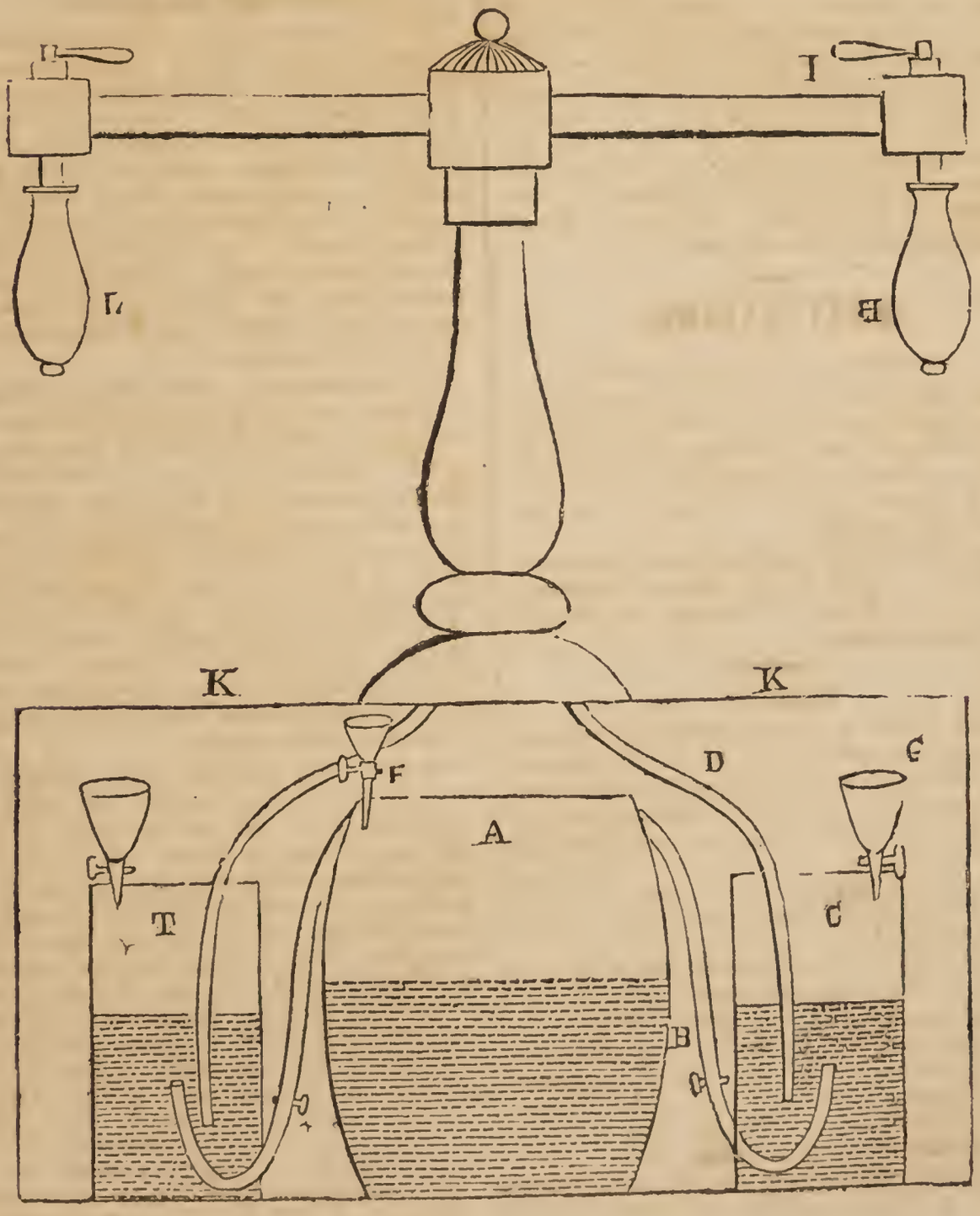
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. **91**, THIRD SERIES. | SATURDAY, JULY 9, 1842. | No. 339, OLD SERIES.

GINGER-BEER OR SODA-WATER FOUNTAIN.



Vol. VIII.—No. 32] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney

GINGER-BEER OR SODA-WATER FOUNTAIN.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—If you think the following description of a ginger-beer or soda-water fountain worthy of notice, it is at your service. I think, also, at the same time, it will give "S. B." all the information he requires.

Description of the Engraving.

K is the counter of the shop; all above this is only for the conveyance of two pipes to H and L; the lower part of the apparatus may be at any distance, as in an adjoining apartment. A is a cask, into which is to be put some powdered chalk, and afterwards a little sulphuric acid and water, through the funnel, F; the chemical action of these liberate carbonic acid gas from the chalk; this gas passes along the pipe, B, into the cask, C, which has been previously partly filled with water through G. It rises through the water, becoming partly condensed by the water, and partly at a pressure above the water; as soon, therefore, as the cock, I, is turned, the condensed gas in C acts upon the surface of the water, and drives it up the pipe, D, to H, where it is drawn off; the other side of the apparatus is precisely the same, except that the water in the cask, T, is flavoured previously with sugar and ginger.

I remain yours, &c.,

H. J. Budd.

IMPROVED HOOKS AND EYES FOR BANDS OF TURNING LATHES.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Cat-gut being composed of a number of threads, is, in consequence, very ill-adapted to have a screw cut on its surface; and, owing to this, the hooks and eyes commonly screwed on the bands of turning lathes, give much trouble, by the giving way of the screws on the band. It appears that this may be obviated by the following plan:—Let there be no screw in the hook and eye; let it be quite plain and a little conical, the apex being inward. The hook and eye must be put on, and slipped farther up the band than it is intended to remain; open the ends of the band, and drive a conical plug in the hollows; let the hook and eye be drawn back to the ends of the gut, by which means the gut will become counter-sunk into the hook and eye, and no force, it appears, could either draw them off the band, or draw out the plug.

I remain yours, &c.,

A. S.

MODE OF SECURING THE NUTS ON AXLE TREES.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Instead of having a male screw on the end of the axle-tree, let there be a square hole in it about half-an-inch deep, and at the bottom of it, a hole with a screw inside. Then provide a square plug to go into this square hole, and having a head to prevent the wheel from coming off. This plug must also have a hole through its length, and, when it is in its place, a screw must be put through it into the axle-tree, so as to keep it from being forced off; the turning of the wheel would have no tendency either to force off the wheel or to unturn the nut.

I remain yours, &c.,

A. S.

ON THE ORIGIN OF THE APPLICATION OF STEAM TO NAVIGATION.

(Concluded from page 243.)

The American engineer, Robert Fulton—another competitor for the merit of having invented and introduced steam navigation—can be proved to be as little entitled to it as Bell; he having also pirated Mr. Symington's invention; as can be established by the following incontrovertible statement:—

It happened one day, during the month of July, 1801, while Mr. Symington was conducting his experiments under the patronage of Lord Dundas, a stranger came to the banks of the canal, and requested an interview: he announced himself as Mr. Fulton, a native of North America, to which country he intended to return in a few weeks; but, having heard of the steam-boat experiments, he could not think of leaving Scotland without waiting upon Mr. Symington, in the hope of seeing the boat and machinery, and procuring some information as to the principles upon which it was moved. He remarked that, however beneficial the invention might be to Great Britain, it would certainly be of more importance to North America; considering her many navigable rivers and lakes, and the ease with which timber could be procured for

building such vessels and supplying them with fuel. He thought fit farther to say, that the usefulness of steam-vessels in a mercantile point of view, could not fail to attract the attention of every observer; and that, if he were allowed to carry the plan to North America, it could not but turn out to Mr. Symington's advantage; as, if inclined for it, or his other engagements would permit, the constructing, or, at least, the superintending the constructing, of such vessels, would naturally devolve upon him. Mr. Symington, in compliance with the stranger's earnest request, caused the engine fire to be lighted up, and the machinery put in motion: several persons entered the boat, and, along with Mr. Fulton, were carried from lock No. 16, where she then lay, about four miles west; and returned to the place from whence they had started, in one hour and twenty minutes, to the astonishment of Mr. Fulton and the other gentlemen present.

Mr. Fulton asked and obtained leave to take notes and sketches of the form, size, and construction of the boat and apparatus: after fully satisfying his curiosity, he took his leave; but he never afterwards had the honour or the gratitude to acknowledge his obligation to Mr. Symington.

It may here, with propriety, be noticed, that Captain Basil Hall lately suggested the steering of vessels at the stem, instead of the stern: a mode adopted in America. Reference to Mr. Symington's boat will show from whence the Americans obtained the idea.

Broken down in spirit, and reduced to much and severe distress, Mr. Symington was unable longer to contend against such a train of disappointments; and his plunderers have since been left in the unmerited possession of the fruits of his anxious, arduous, and expensive labours.

When a committee of the honourable House of Commons was appointed to inquire into the nature of the engines employed on board of steam-boats, James Walker, Esq., kindly interested himself, and sent notice to Mr. Symington, then in Scotland, that he thought it would be proper to get a memorial drawn up and laid before the committee; unfortunately, before this could be accomplished, Mr. Symington was informed that the investigation had terminated.

When it is borne in mind that Mr. Symington not only benefited his country by his inventive powers, but also paid into the national coffers a sum exceeding what he ever received, for the purpose of purchasing protection for his rights—protection which was a mockery; when it is made known that Mr. Bell obtained 200*l.* from Mr. Canning; and that when, by the advice of intelligent and respectable friends, Mr. Symington attempted to bring his claims before Parliament, by means of petition, Mr. Goulburn, then Chancellor of the Exchequer, refused to allow its being presented, alleging the subject had previously been frequently before him; surely it cannot be said Mr. Symington was too liberally treated. He always believed Mr. Goulburn, in making this assertion, was mistaken; as, when 150*l.* were awarded, Lord Goderich and Mr. Canning were Chancellors of the Exchequer.

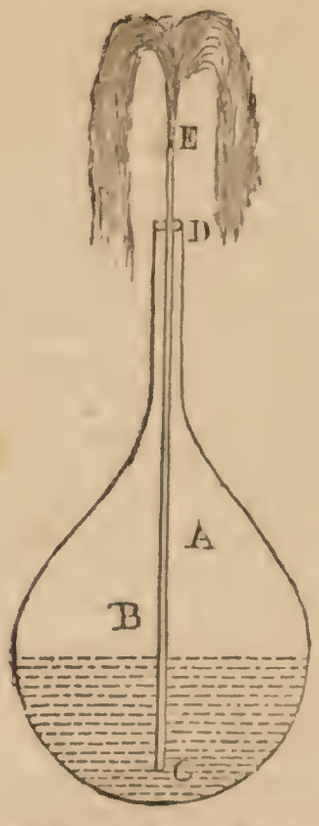
After this disappointment, Mr. Symington gave up all hope of having justice done to him, and soon after became so much an invalid, as to render him unable to quit his bed room. Before any measures could be adopted to convince Mr. Goulburn of the justice of his claims, political changes of so unexpected and extraordinary a nature occurred, as to render it unnecessary to remove the seemingly erroneous impressions of that gentleman respecting them, and impolitic to appeal to the public judgment at a time of so much excitement.

It has been mentioned that Mr. Symington's health had long been in a declining state; and it was evident for weeks, not only to those around him, but even to himself, that his end was fast approaching. As it drew nigh, he exhibited the utmost fortitude and resignation; and even on the last day of his existence, he afforded an instance of magnanimity and goodness of heart deserving of record. His son-in-law, with whom he resided, was, at that time, with three of the family, labouring under a dangerous and malignant fever, and it was dreaded the disease might affect the other inmates of the dwelling. Less mindful of himself than those of who were dear to him, Mr. Symington endeavoured to encourage his daughter to bear up against her calamities, and to look forward with hope to the termination of the malady which was placing the lives of so many of the domestic circle in jeopardy. To his wife and son, who were likewise standing by his bedside, he also attempted to offer consolation. Invoking blessings on all around him, he besought them not to grieve on his account; for that whatever he might formerly have done to benefit others, he was now a useless sufferer, and wished to be at rest. Requesting his infant granddaughter, to whom he was much attached, might be brought to him, his wish was complied with; and,

taking the child in his arms, he blessed her, and prayed she might be a blessing to her parents, whom he trusted might yet both be long spared to protect her. A few hours afterwards, and on the 22nd of March, 1831, he expired, in what might truly have been termed the house of sorrow and severe affliction.

Thus died an ingenious and ingenuous man; one who, possessed of the highest talents, possessed not that knowledge of the world to enable him to guard against duplicity; and who, when he found he had been taken advantage of, had too independent and indignant a spirit to trumpet forth his distresses or proclaim his wrongs.

A SIMPLE FOUNTAIN.



To the Editor of the Penny Mechanic and Chemist.

Sir,—As some of your junior readers may be fond of hydraulics, &c., I send you a sketch and directions for making a very simple, but pretty, fountain:—

A is a Florence flask; B, a glass tube; C, the end of the tube, which must go within one-eighth of an inch of the bottom of the flask; D is the mouth of the flask where the tube must be cemented in, quite air-tight; E, the end of the tube from which the water issues, which should be covered with sealing-wax, and then pierced with a hot needle, so that the orifice may be very small. To set this fountain off, fill it half full, by exhausting the air with the mouth, and placing the finger end over the end of the pipe, so that none of the air which has been exhausted, may get in again; then invert it, and place the end in water, and the water will mount up the pipe into the flask. Continue to do so till the vessel is half full; then apply the mouth, and blow down the hole, until you have forced as much air in it as you are able; then place your finger over the hole, and gently warm it over a candle or fire; then remove the finger, and the fountain will play, and continue to do so, till nearly all the water is exhausted, and it must then have more air compressed into it as before; and when the water is exhausted, it must be filled by the same process as before.

I remain yours, &c.,

A Young Chemist.

HISTORY OF MEDALS.

(Continued from page 247.)

Many different names have been imposed on the coins belonging to the different states of Greece: thus, Κορη, the maiden, was a name often applied to the tetradrachm, and which would seem to apply to those of Athens; though there are coins of other cities with the head of Proserpine, and the word Κορη, to which it would appear more applicable, in our author's opinion. Χελωνε, the shell, was the name of another coin, from its type. A Sicilian coin was named Δεμαρετιον, from Gelon's wife. A tetradrachm was named Κραπαταγους, and had eight ενθειας or hemidrachms. The Τροισηνιον, so called from its country, Troizene, had Pallas on one side and a trident on the reverse. The hemiobolion was the πελανορ of Lacedæmon; and the κολλυβος is supposed to have been equal to the Roman sestertius or quarter drachma. The cystophori were coins with the mystic chest or hamper of Bacchus upon them, out of which a serpent rises; and are much celebrated in antiquity. We are told by Livy, that Marcus Acilius, in his triumph over Antiochus and the Ætolians, carried off 248,000 of them; Cneius Manlius Vulso, in that over Gallo-Græcia, had 250,000; and Lucius Emilius Regillus, in his naval triumph over the fleets of Antiochus, had 131,300. Cicero likewise mentions his being possessed of a vast sum in them. The most probable opinion concerning them seems to be, that they are all silver tetradrachms; such as belong to the cities of Apamea and Laodicea in Phrygia; Pergamus in Mysia; Sardis and Tralles in Lydia; and Ephesus; but it is a mistake to ascribe any to Crete. Mr. Pin-

kerton thinks it absurd to imagine that Crete, a small island, should strike such vast numbers of coins; though Cicero mentions his being in possession of an immense treasure in them, at the time he was governor of Asia Minor. "It is most likely," says Mr. Pinkerton, "that his wealth should be in the coin of the country to which he belonged. But what had these triumphs of Cicero's government to do with Cretan money? But, indeed, the coins themselves, as above noticed, establish the fact."

The most particular attention, with regard to the names and standard of coins, is due to those of Athens; and it is most remarkable, that most of them which have reached us, are of a very late period, with the names of magistrates inscribed upon them. Some of these bear the name of Mithridates, and few are older than the era of that prince; who, it is well known, took the city of Athens in his war with the Romans. "I suspect," says Mr. Pinkerton, "that no Athenian coins of silver are posterior to Sylla's infamous destruction of that city; an event the more remarkable, as Sallust tells us, that Sylla was learned in Greek. Indeed Caligula, Nero, and most of the pests of society, have been learned men, in spite of a noted axiom of Ovid,

> Sed ingenuas didicisse feliciter artes
> Emollit mores, nec sinit esse feros.

It is still more remarkable, that the fabric of Athenian coins is almost universally very rude; a singular circumstance, if we reflect how much the arts flourished there. It can only be accounted for, from the excellence of their artists being such as to occasion all the good ones to be called into other countries, and none but the bad left at home. In like manner, the coins struck at Rome, in the imperial times, are excellent, as being done by the best Greek artists; while those of Greece, though famous at that time for producing miraculous artists, are, during that period, commonly of very mean execution. The opulence of Athens in her days of glory, was very great; owing, in an eminent degree, to her rich commerce with the kingdoms on the Euxine Sea, carried on chiefly from Delos, which belonged to Athens, and was the grand centre of that trade." Hence it has become matter of surprise to Neumann, that, when there are so many coins of Mycene, an island, even, proverbially poor, there should be none of Delos. But Mr. Pinkerton accounts for this, from Mycene's being a free state, and Delos subject to Athens. "It may be well supposed," says he, "that Athens had a mint at Delos; and such Athenian coins as have symbols of Apollo, Diana, or Latona, were struck in this island."

The copper money of the Greeks is next in antiquity to the silver. Mr. Pinkerton is of opinion, that it was not used at Athens till the twenty-sixth year of the Peloponnesian war, about 404 years before Christ, and 300 after silver was first coined there. The first copper coins were those of Gelo, of Syracuse, about 490 B. C.

THE CHEMIST.

POTASSA.

Mr. Davy, in his first attempts, exposed the alkali, dissolved in water, to the action of the galvanic battery, but the water alone of the solution was decomposed. Potassa, in fusion, was then placed in the galvanic circuit; a vivid light, and appearances of the production of combustible matter, were observed; on submitting the solid alkali, rendered a conductor of electricity by being very slightly moistened, to the galvanic action, these appearances were still better marked; and it was in this way Mr. Davy succeeded in effecting the complete decomposition.

"A small piece of pure potash, which had been exposed a few seconds to the atmosphere, so as to give conducting power to the surface, was placed upon an insulated disc of platina, connected with the negative side of the battery in a state of intense activity, and a platina wire, communicating with the positive side, was brought in contact with the upper surface of the alkali. Under these circumstances, a vivid action was observed to take place. The potash began to fuse at both its points of electrization. There was a violent effervescence at its upper surface; at the lower or negative surface, there was no liberation of elastic fluid; but small globules, having a high metallic lustre, and being precisely similar, in visible characters, to quicksilver, appeared; some of which burnt, with an explosion and bright flame, as soon as they were formed, and others remained, and were merely tarnished, and finally covered with a white film, which formed on their surfaces. These globules, numerous experiments soon showed to be the substance I was in search of, and a peculiar inflammable principle, the basis of potash."

The platina, Mr. Davy found, had no share in its production; as it was equally produced when even charcoal and other

metals were used, for completing the electrical circuit. The phenomena, too, were quite independent of the presence of air.

As, in the decomposition of compound substances by galvanism, Mr. Davy had found that, when combustible bases had been developed at the negative side, oxygen is evolved at the positive side, it was reasonable to conclude that this happened in the above experiment, and that the effervescence observed at the part of the potassa in immediate contact with the positive wire, was due to the disengagement of oxygen gas. He accordingly found, performing the experiments in glass tubes, so as to collect the aërial product given out at the positive surface, that this, on the most delicate examination, proved to be pure oxygen; and, unless an excess of water was present, no gas was evolved from the negative surface, nothing being produced there but the inflammable globules.

By these analytic experiments, therefore, potassa is proved to be a compound of a peculiar substance, highly inflammable, and having a metallic lustre, with oxygen. And this Mr. Davy soon confirmed by synthetic experiments.

He found, that the metallic lustre of this inflammable substance immediately became destroyed in the atmosphere, and a white crust formed upon it, which was pure potassa. This was soon dissolved, by attracting humidity from the air; a new quantity was formed on the surface, until the whole disappeared, and had formed a saturated alkaline solution. When the globules were placed in tubes containing atmospheric air or oxygen gas, an absorption of oxygen took place, and a crust of alkali was formed. When they were strongly heated, confined in given portions of oxygen, a rapid combustion, with a brilliant white flame, was produced, and they were converted into a white and solid mass, which was found to be potassa; oxygen was absorbed, and nothing emitted which affected the purity of the residual air. From subsequent experiments, Mr. Davy endeavoured to determine the proportions of these elements. From the products of the combustion of the base, compared with the quantity of oxygen absorbed, he inferred, taking the mean of two experiments, that potassa consists of 86.1 of base and 13.9 of oxygen. From the results of the decomposition of water by the base the proportions indicated were 84 of base, and 16 of oxygen. The mean of these will be 85 and 15.

The decomposition of potassa may be effected without difficulty, with a galvanic battery of not very high powers. One of 100 plates, of six inches square, is sufficient.

An important confirmation of the discovery, is that which has been received from an experiment performed by Guy Lussac and Thenard. It occurred to these chemists, that potassa might be decomposed, by causing a substance to act on it, having a strong attraction for oxygen. They put clean iron filings into a gun-barrel, bent so that the filings in the curvature could be raised to a sufficient heat, by the barrel being placed across a furnace. With one extremity of it a tube is connected, containing solid potassa. When the iron filings in the barrel are brought to a white heat, the alkali in the tube, which has been previously kept cold by a freezing mixture, is melted, by applying heat to it by a portable furnace; and it is allowed to run through, by a small aperture, upon the iron filings. It suffers decomposition; the iron attracts its oxygen, and the inflammable base is sublimed to the other end of the tube, which is kept cold, so as to condense it; a tube of safety, containing a little mercury, being connected with the extremity, to allow of the disengagement of any aërial matter, and, at the same time, exclude the air. Hydrogen gas is disengaged during the process, which appears to be derived from the decomposition of water contained in the alkali, and the result is most successful when the alkali is in the driest state. The base of the alkali is obtained in the form of brilliant laminæ, adhering to the side of the gun-barrel. There is also found in the curvature where the filings were contained, an alloy of it with iron. According to Mr. Davy, who performed the experiment with success, the base thus obtained is rather heavier than that procured by electricity, probably from containing a little iron. To the matter discovered by these researches, as the base of potassa, the name of potassium has been given.

MISCELLANEA.

Zoological Weather-glass.—In the post-house at Schwartzengen, two frogs are kept in a glass jar, about six inches in height, and six inches in diameter, with water at the depth of three or four inches at the bottom, and a small ladder reaching to the top of the jar. On the approach of dry weather the frogs mount the ladder, and, when wet weather is expected, they descend into the water. These animals are of a bright green, and, in their wild

state. climb the trees in search of insects, and make a peculiar singing noise before rain. In the jar, they get no other food than now and then a fly, one of which would serve a frog for nearly a week, though it will eat from six to twelve in a day, if it can get them. In catching the flies put alive into the jars, the frogs display much adroitness.

To Preserve Wood from Decaying.—Immersion in sand, mud, or water, *preserves* wood for many centuries. Salt, corrosive sublimate, sulphate of iron, or copperas, of alum, &c., arrest the *putrefactive process* of timber. Drying or seasoning also is a security. Sir John Pringle has determined the power of various salts to arrest putrefaction or decomposition, as follows:—

Sea salt	1
Vitriolated or soluble tartar and minderus	2 3
Sal ammoniac and saline mixture	4
Nitre, hartshorn, and wormwood	2
Borax	10
Salt of amber	20
Alum and myrrh	30
Bark	120
Cam	300

Starch is converted into sugar, by boiling for forty hours, equal weights of starch and water with 1-100th part of sulphuric acid, water being resupplied for evaporation. The acid is neutralized by time, and the sugar crystallizes. One pound and a half of potato starch produces one pound and a quarter of brown sugar. Starch dissolved in dilute acid is converted, at a certain temperature, first into gum, and then into sugar of grapes. On abstracting the acid, only the sugar remains, rather heavier than the starch.—*Phillips.*

Water which boils at 21° at the foot of Mont Blanc, boils at 187° at the top; while the barometer at bottom was 30.534°, and at the top 17.136°. Then the elevation being 15,000 feet in 25° of Fahrenheit, every 600 feet of elevation lowers the boiling point 1° of heat.

Errors of the Poor.—The notions which so closely connect in their minds the invention and application of machinery with their own distress, are among the results of a want of knowledge most devoutly to be deprecated. Could the machinery of this country be by one stroke of a giant arm annihilated, what tongue can tell the results, the tremendous results of misery that would instantly be realized? Earth has never yet seen—no siege of a city, however protracted—no war, however bloody and desolating—no revolution, however wild and ferocious, has ever shown a parallel for the misery that would instantly descend upon the heads of millions, could any such idea be realized. The means not only of clothing, but of food, of migration, would instantly fail us; we should be shut up from the rest of the world; we should be reduced into a state in which it would not be strange if even cannibalism were to ensue. The hostility to machinery, to be consistent, must be universal. Each class of workmen has the same right; and if the agricultural labourer be justifiable in destroying the thrashing-machine, the weaver has a right to destroy the power-loom; the printer's pressman would be right in destroying the steam-press; the waterman would be right in dismantling the steam-vessel; and so, throughout the whole compass of society, we should be thrown back into a state of privation, helplessness, and utter barbarism.—*Lectures by W. Fox.*

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, July 13, Mrs. C. L. Balfour, on the Moral and Intellectual Influence of Woman. Friday, July 15, E. J. Hytche, Esq., on the Application of Phrenology to Education and Criminal Legislation. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, July 14, Dr. Wilks, on Vegetable Physiology. At half-past eight.

QUERIES.

Sir,—It is gratifying to know that so valuable a Journal exists, devoted, as it is, to the calls of the more humble class of people; to assist them in their rights, as much as information can furnish, to put forth their claim of merit to the higher class; and, above all, the most inestimable manner and facility in which they find a method to obtain valuable information, by the favourable attention to their questions by the more scientific portion of your readers. I doubt not, but the following question may be so fortunately taken up by some of your correspondents, though it may be a question somewhat bearing to medical, yet, I think, it has some tendency to chemical, analyzation. It is a circumstance, I believe, well known, that in a room where a great quantity of people are assembled—as a public ball-room or a private party—the atmospheric air is very much impaired by the breath of each person present, for each person is breathing a portion of the others' breath; and hence it is, that, if only one person be in a sickly or diseased state, the air is rendered more impure, which, if I am not mistaken, is, in a great measure, the cause of diseases running throughout the whole of large factories,

where many are employed. Now if the fumes of tobacco be introduced (I do not exactly mean into factories), I think it is generally allowed, that it renders the air they breathe less infectious. If any of your scientific medical or chemical correspondents would inform me if it be a benefit or not, they would oblige not only me, but numerous others of your readers. Also, I should feel obliged if any of your correspondents would inform me, what the ashes of tobacco or cigars are composed of, when burnt or smoked, and if they be or can be, applied to any use? J. W.

In reading your PENNY MECHANIC, I found a description of the "Hydraulic Ram," invented by "Lewis;" but, I must confess, I do not yet understand the action of the apparatus. "Mr. Lewis" would oblige me by giving, through your work, a fuller description of the invention.

JOHN SOULBY.

The method of gilding on glass? A. B.

1. How to make fumigating pastils? 2. In the PENNY MECHANIC of the 28th of May, a description of an electrophorous was given. If the sealing-wax be poured into a tin raised at the edges, will it answer the same purpose as being poured on wood? There is a difficulty in obtaining wood that will bear the heat of the wax without warping. If the wax be dissolved in alcohol, will it answer as well? 3. Has any of your readers a cheap second-hand plate-electrical machine to sell? W. C., Jun.

Some time ago your publication gave a receipt for Lucifer matches (equal proportions of oxymuriate of potash and sulphur in powder); I want a composition that is very sensitive—that is, ignite, not explode, under moderate friction—for an experiment unconnected with matches; but the above will only ignite by a blow or explode; friction will not ignite it at all. I have added a little nitre, but still it fails. Perhaps phosphorus might make it succeed; but I do not know how to blend phosphorus with the other ingredients safely, and I also fear, that its spontaneously inflaming will defeat my object. All the chemists I have applied to, stared at me as if they had a Guy Fawkes before them, and seemed alarmed; although some were told that it was for a purpose likely to bring the composition, if the experiment succeed, into daily consumption. I shall, therefore, feel obliged if any of your talented correspondents can favour me with directions; also, by what liquid I can make it into cakes about the size of a pea. Will chlorine of potash be serviceable, and with safety; and can it be made to ignite by friction, blended with other and what articles? I know it will ignite by contact with vitriolic acid, but doubt that it will with pyroligneous acid. Friction will answer my purpose best. IGNORAMUS.

["Ignoramus's" communication has been mislaid a long time, for which we must apologize.—ED.]

What quantity of sal ammoniac should be put into the porous cell for the electrotype, which holds half-a-pint? I have made two attempts, and the copper has fallen off the mould in a rotten state? Also, what quantity of sulphate of copper should be put in the trough which holds a pint? H. J. BUDD.

ANSWERS TO QUERIES.

To Preserve the Skins of Beasts and Birds.—Powder lime, 4 drachms; camphor, 5 drachms; white soap, two oz.; arsenic in powder, 2 oz.; salt of tartar, 12 drachms. H. J. BUDD.

To make a Stanhope Lens.—Procure a piece of glass tube, about a quarter of an inch diameter, and three-eighths long, and grind each end convex on a common grind-stone. This done, fasten a brass or iron chuck upon the mandrel of a lathe, and turn in the centre of the face of the chuck, a semi-circular hole of proper size, just to admit the end of the tube; put a little fine sand or emery powder into this hole; put the lathe in motion, when, upon holding the glass tube steadily against the sand, the end of it will be ground to a true semi-circular surface; which requires afterwards to be polished by another similar chuck, with putty powder, instead of sand.

To make a Spherical Lens.—Procure a piece of thin platinum wire, and twist it once round a pin's point, so as to form a minute ring with a handle to it. Break up a piece of flint glass into fragments, about the size of mustard seed, or a little larger; place one of these pieces on the ring of wire, and hold it in the point of the flame of a candle or gas-light, when the glass will melt, and assume a complete lens-like or globular figure. Let it cool gradually, and keep it for mounting.

A Test for Silver.—Dissolve a piece of the metal to be examined, in pure nitric acid; then dilute it with water, and stir it about with a bright copper wire; if any silver be present, it will precipitate upon the copper, covering it with silver. Or add a little table-salt to the solution, and a white cloud of muriate of silver will fall down.

To make Bronze for Brass.—One ounce of muriate of ammonia, half-an-ounce of alum, and a quarter of an ounce of arsenic, dissolved in a pint of strong vinegar, will make a good bronze for brass work.

"N. N." A piece of clay will take sulphuric acid from a solution of sulphate of copper.

"J. W. D." will find chlorate of potass, when heated to redness in a glass retort, the best and quickest method of obtaining pure oxygen gas for immediate use.

TO CORRESPONDENTS.

R. J. C.—*The dissolving views at the Polytechnic Institution are now on an enlarged scale. Both series are shown every evening at a quarter before ten.*

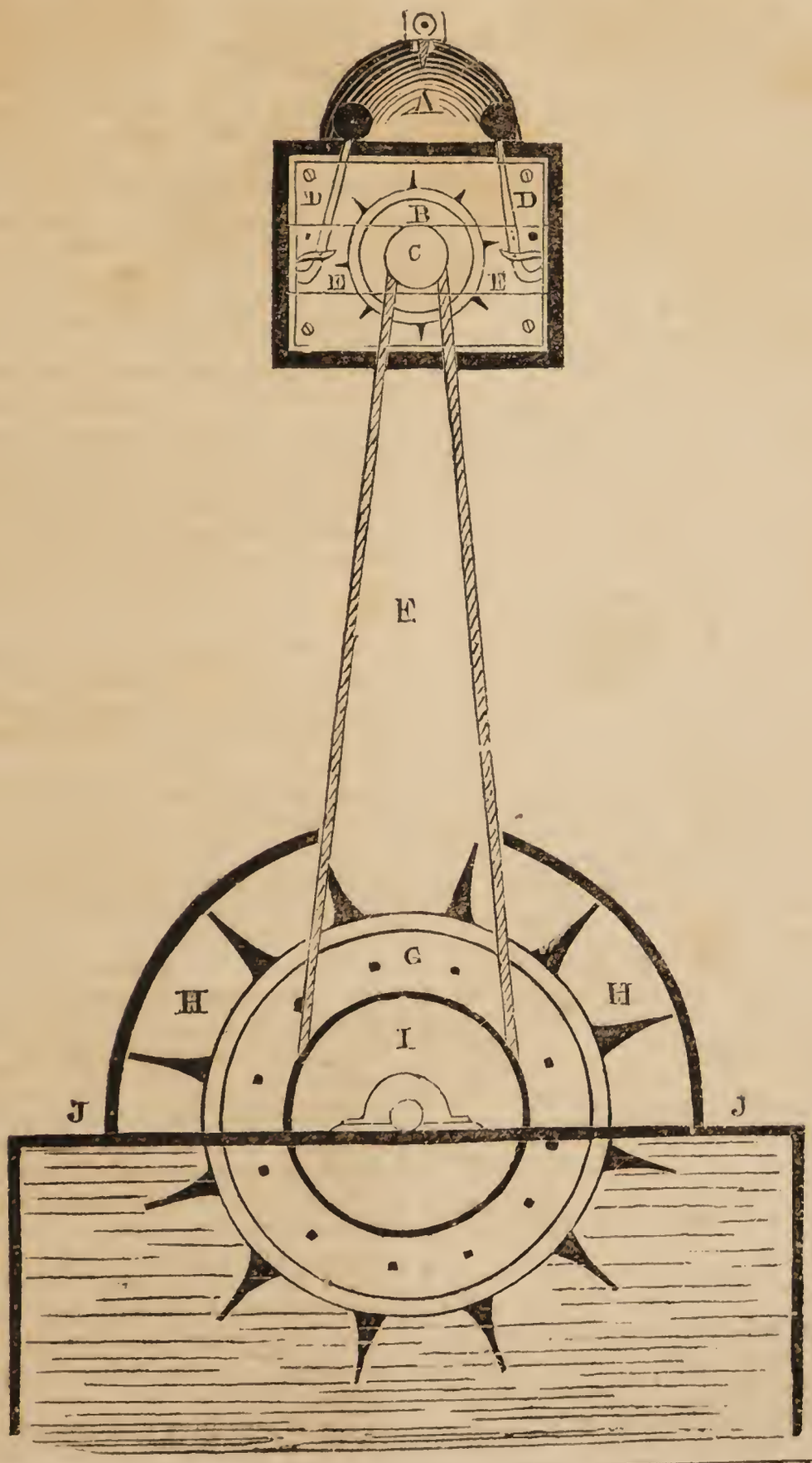
W. S.—*We shall be happy to afford him all the information he requires; but it will be necessary for him to explain the precise object he has in view.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.
A MAGAZINE OF THE ARTS AND SCIENCES.

No. 92, THIRD SERIES. | SATURDAY, JULY 16, 1842. | No. 340, OLD SERIES.

FOG-ALARUM, TO PREVENT THE COLLISION OF VESSELS AT SEA.



Vol. VIII.—No. 33.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney

FOG ALARUM,

TO PREVENT THE COLLISION OF VESSELS AT SEA.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

SIR,—The following is a description of a fog-alarum I have constructed, to supersede the use of the fog-horn, which is productive of such dangerous effects to the person using it. Several instances there are in which persons have lost the powers of speech for weeks together. The use of the fog-alarum is, to prevent the collision of vessels at sea, on rivers, &c., and is not worked by manual labour, water being the propelling power, both when the vessel is stationary and in motion. The alarum can be placed at any convenient part of the vessel, and does not require any attendance, except to stop it when not required for use.

Description of the Engravings.

Fig. 1 is a sectional diagram of the alarum.

FIG. 2.

Fig. 2, an enlarged view of the action of the motive wheel upon the lever attached to the bell-hammer. The description answers the letters to both diagrams:—

A is the bell; B, the motive wheel; C, the pulley; D, bell-hammers; E, levers; F, connecting rope; G, paddle-wheel; H, paddle-box; I, pulley attached to the paddle-wheel: J, water-mark.

The centre of paddles to be placed on the water-mark line of the hull of the vessel; connexion to be made with the alarum by an endless chain or rope. One revolution of the paddles makes three of the wheel that works the hammers, in which are contained eight teeth; consequently, there are twenty-four strokes of the hammer to one revolution of the paddles; and, supposing them to be ten feet in circumference, they would make 528 revolutions in one mile (if standing water), and the vessel sailing at ten knots (miles) per hour, there will be 2112 strokes per minute on the bell.

I remain yours, &c.,

T. R. BILBROUGH.

SMOKE-CONSUMING FURNACE.

To the Editor of the Penny Mechanic and Chemist.

SIR,—As the consumption of smoke from furnaces is exciting an interest so very general, and is of so much importance in great towns, I here send you a plan of a furnace or furnaces for consuming smoke.

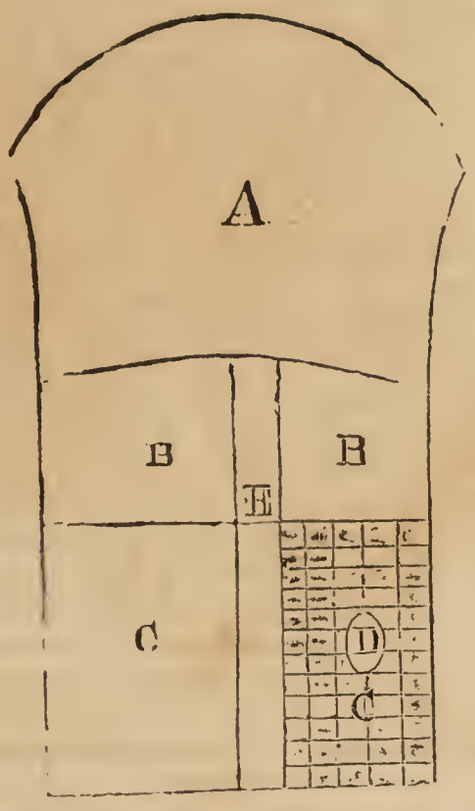
Description of the Engraving.

A, the boiler; B B, two furnaces; C C, ash-pits; D is a table to admit air to the small furnace; E is a wall, one brick thick, to divide the furnace and ash-pit into two each. The bridge in the larger furnace (not seen in the engraving) must be built up to the boiler, with a hole left, sixteen inches square, for the mouth of the flue; this flue must pass down into the ash-pit of the small furnace, and terminate under, and in front of, the small furnace. The tube, D, must terminate near it, so that the carburetted hydrogen gas from the flue may enter into combination with the oxygen of the air admitted through the tube.

It is evident that the smoke, in combination with the oxygen, must be burnt while passing through the small furnace. The small ash-pit must be built up in front, and the tube, D, inserted in the wall. The grate of the small furnace must be about twenty inches broad and thirty inches long, with bars three-fourths of an inch thick, and set about one inch asunder, for the better division of the gases.

I will now give a chemical explanation of the process of burning smoke. Com-

bustion cannot take place without the presence of oxygen, and is more rapid in proportion to the quantity of this agent in



contact with the inflamed body. From this it is clear, that it depends simply on the supply of air to the furnace, and confining the unburnt gases so near the same, that their temperature shall be sufficiently high to produce combustion.

I remain yours, &c.,

J. S. W.

PREPARATION OF WICKS FOR CANDLES.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Many processes have been recommended by chemists, with a view of obviating the necessity which exists, in the case of ordinary candles, of continual snuffing. The method adopted by Mr. Palmer in the manufacture of his "patent lamp candles," is, according to Dr. Ure, the saturation of the wick, previously to dipping, in a solution of subnitrate of bismuth; although, owing to the extreme insolubility of this salt, I am somewhat at a loss to conceive how it can be rendered applicable for the purpose in question. However, after reading the article, to which I have just referred, in the Doctor's "Dictionary of the Arts and Manufactures," I have been induced to give a little attention to the subject, and, accordingly, beg to offer to your notice the following simple and unexpensive method for attaining the object under consideration. It consists, then, in immersing the wicks in a weak solution of nitrate of potash, well drying them, and afterwards plunging them, as usual, into the tallow-vat. The candles, thus formed, owing to the oxygen furnished by the salt to their wick, are, I conceive, incapable of giving rise to the carbonaceous deposit denominated the snuff, or even of generating that disagreeable and unpleasant product of ordinary combustion, so well known as the smoke.

Hoping that the above hint may be acceptable to some of your numerous readers,

I remain yours, &c.,

W. H. O.

[We have inserted our correspondent's letter; but he will find, if he make the experiment, that the saturation of the wick in any chemical solution, will not answer the purpose without the metallic wire, as used by Mr. Palmer.—Ed.]

CAUSES OF RAIN.

It is universally agreed that rain is produced by the water previously absorbed by the heat of the sun, or otherwise, from the terraqueous globe, into the atmosphere; but very great difficulties occur, when we begin to explain why the water, once so closely united with the atmosphere, begins to separate from it. We cannot ascribe this separation to cold, since rain often takes place in very warm weather; and though we should suppose the condensation is owing to the superior cold of the higher regions, yet there is a remarkable fact which will not allow us to have recourse to this supposition. It is certain that the drops of rain increase in size considerably as they descend. On the top of a hill, for instance, they will be small and inconsiderable, forming only a drizzling shower; but at the bottom of the same hill, the drops will be excessively large, descending in an impetuous rain; which shows that the atmosphere is disposed to condense the vapours, and actually does so, as well where it is warm as where it is cold.

For some time the suppositions concerning the cause of rain, were exceedingly insufficient and unsatisfactory. It was imagined that, when various congeries of cloud were drawn together by the agitation of the winds, they mixed and ran into one body, by which means they were condensed into water. The coldness of the upper parts of the air, also, was thought to be a great means of collecting and condensing the clouds into water, which, being heavier than the air, must

necessarily fall down through it in the form of rain. The reason why it falls in drops, and not in large quantities, was said to be the resistance of the air, whereby, being broken and divided into smaller parts, it at last arrives to us in small drops. But this hypothesis is entirely contrary to all the phenomena; for the weather, when coldest—that is, in the time of severe frost—is generally the most serene. The most violent rains also happen when there is little or no cold to condense the clouds; and the drops of rain, instead of being divided into smaller ones as they approach the earth, are plainly increased in size as they descend.

Dr. Derham accounted for the precipitation of the drops of rain, from the vesiculæ being full of air, and, meeting with air colder than they contained, the air they contained was, of consequence, contracted into a smaller space, and, consequently, the watery shell rendered thicker, and thus specifically heavier than the common atmosphere. But it has been shown, that the vesiculæ, if such there be, of vapour, are not filled with air, but with fire or heat; and, consequently, till they part with this latent heat, the vapour cannot be condensed. Now cold is not always sufficient to effect this; since, in the most severe frost, the air is very often serene, and parts with little or none of its vapour for a very considerable time. Neither can we admit the winds to have any considerable agency in this matter; since we find that blowing upon vapour is so far from condensing, that it unites more closely with the air, and wind is found to be a great promoter of evaporation.

According to Rohault, the great cause of rain is the heat of the air, which, after continuing, for some time, nearer the earth is raised on high by a wind, and, there thawing the snowy villi or flocks of half-frozen vesiculæ, reduces them to drops, which, coalescing, descend.

Here, however, we ought to be informed, by what means these vesiculæ are suspended in their half-frozen state, since the thawing of them can make but little difference in their specific gravity; and it is certain that they ascended through the air not in a frozen, but in an aqueous state.

Dr. Clarke and others ascribe this descent of the rain, rather to an alteration of the atmosphere, than of the vesiculæ, and suppose it to arise from a diminution of the elastic force of the air. This elasticity, which, they say, depends chiefly or wholly upon terrene exhalation, being weakened, the atmosphere sinks under its burden, and the clouds fall. Now the little vesicles, being once upon the descent, will continue therein, notwithstanding the increase of resistance they may around meet with; for, as they all lead to the centre of the earth, the farther they fall, the more coalitions they will make, and the more coalitions, the more matter will there be under the same surface, the less resistance will there be to the same matter. Thus, if the cold act early enough to precipitate the ascending vesicles before they are arrived at any considerable height, the coalitions being but few, the drops will be proportionally small, and thus is formed a dew. If the vapour become copious, and rise a little higher, we have a mist or fog: a little higher still, and they produce a small rain. If they neither meet with cold nor wind, they form a heavy, thick, dark sky. This hypothesis is equally unsatisfactory with the others; for, granting that the descent and condensation of the vapours are owing to a diminution of the atmosphere's elasticity, by what is this diminution occasioned? To say that it is owing to terrene exhalations, is only solving one difficulty by another; since we are totally unacquainted, both with the nature and operation of these exhalations. Besides, let us suppose the cause to be what it will, if it act equally and at once upon all the vapour in the air, then all that vapour must be precipitated at once; and instead of gentle showers, continuing for a considerable length of time, we should have the most violent waterspouts, continuing only for a few minutes, or, perhaps, seconds, which, instead of refreshing the earth, would drown and lay waste everything before them.

(To be continued.)

HISTORY OF MEDALS.

(Continued from page 253.)

The chalcos of brass, of which eight went to the silver obolus, seems to have been the first kind of Greek coin. At first, it was looked upon as of so little consequence, that it became proverbial; and to say that a thing was not worth a chalcos, was equivalent to saying that it was worth nothing. As the Greeks became poor, however, even this diminutive coin was subdivided into two, four—nay, eight λεπτα or small coins; but our author censures very severely those who have given an account of those divisions. "Pollux and Suidas, copying from him," says he, "tell us, that there were seven lepta to one chalcos; a number the most unlikely

that can be, from its indivisibility and incapacity of proportion.

"Pollux lived in the time of Commodus, so was too late to be of the smallest authority; Suidas is four or five centuries later, and out of the question. Pliny tells us, that there were ten chalci to the obolus; Diodorus and Cleopatra, that there were six; Isidorus says there were four; and if such writers differ about the larger denomination, we may well imagine that the smaller equally varied in different states; an idea supported by these undeniable witnesses, the coins which remain. Most of the Greek copper coin which has reached our times, consists of chalci; the lepta being so small, as to be much more liable to be lost." In Dr. Hunter's cabinet, however, there are several of the dilepta of Athens; and, from being stamped with the representation of two owls, seem to be the same with the silver diobolus; "a circumstance," says Mr. Pinkerton, "of itself sufficient to confute Pollux; for a dilepton can form no part of seven; a number, indeed, which never appeared in any coinage of the same metals, and is contradictory to common sense. It may be observed, that the whole brass coins of Athens, published by Dr. Combe, are reducible to four sizes, which may be the lepton, dilepton, tetralepton or hemichalcos, and chalcos. The first is not above the size of one of King James the First's farthing tokens; the last about that of our common farthing." The lepta was also called *κερμα*, as being change for the poor. The *κιδαβος*—perhaps so called from the figure of a wolf upon it—was the coin of a particular state, and if of brass, must have weighed three chalci. The other names of the copper coins of Greece are but little known. Lycurgus ordered iron money to be coined at Sparta; but so perishable is this metal, that none of that kind of money has reached our times.

After the conquest of Greece by the Romans, most of the coins of that country diminished very much in their value, the gold coinage being totally discontinued; though some of the barbarous kings who used the Greek character, were permitted to coin gold, but they used the Roman model; and the standard used by the few cities in Asia, who spoke the Greek language in the times of the emperors, is entirely unknown. Copper seems to have been the only metal coined at that time by the Greeks themselves; and that upon the Roman standard, then universal through the empire, that there might be no impediment to the circulation of currency. They retained, however, some of their own terms, using them along with those of the Romans. The assarion or assarium of Rome, the name of the diminished *as*, being sixteen to the drachma or denarius, the obolus was so much diminished in value, as to be struck in brass not much larger than the old chalcos, and valued at between two or three assaria, which was, indeed, its ancient rate as to the drachma. This appears from the copper coins of Chios, which have their names marked upon them. The brass obolus, at first equal in size to the Roman sestertius or large brass, lessens by degrees to about the size of a silver drachma. From the badness of the imperial coinage in Greece, also, it appears that brass was very scarce in that country, as well as in all the cities using the Greek characters; being found mostly in the western countries of the Roman empire. The time of this declension in size of the Greek coins, is, by Mr. Pinkerton, supposed to have been from Augustus down to Gallienus. He is of opinion, however, that the copper obolus, at first above the size of large brass, was used in Greece about the time of its first subjection to Rome; and that the lepta ceasing, the chalci came in their room, with the dichalcus and the hemiobolion of brass.

With respect to the gold coins of the Greeks, Mr. Pinkerton is of opinion, that none of that metal was coined before the time of Philip of Macedon, as none have reached our times prior to the reign of that monarch. From a passage in Thucydides, our author concludes that, in the beginning of the Peloponnesian war, the Athenians had no gold coin. Mentioning the treasure in the Acropolis or citadel of Athens, at the commencement of that war, the historian mentions silver coin, and gold and silver in bullion; and, had any of the gold been in coin, he would certainly have mentioned it. Philip began his reign about sixty-eight years after the beginning of the Peloponnesian war; and we can scarce suppose that any city would have preceded the elegant and wealthy Athens in the coining of gold.

THE CHEMIST.

EFFECTS OF HYDROGEN GAS.

To the Editor of the Penny Mechanic and Chemist.

Sir,—If you deem the following worthy a place in your valuable Journal, for the instruction of any of your readers, you have the liberty to insert it.

Hydrogen, like all other combustibles, will not burn, unless in contact with atmospheric air, or some substance that contains oxygen. If a portion of atmospheric air be mixed with this gas, and fire be applied, it will explode with violence. It is related of one Pilater-de-Rosier, that, having mixed one part of common air with nine parts of hydrogen gas, and drawn the mixture into his lungs, it caught fire by accident, as he respired it, and the whole of the gas exploded in his mouth, and nearly deprived him of his life. The shock was so violent, that, at first, he thought the whole of his teeth had been driven out; but, fortunately, he received no lasting injury. Professor Parkes, being engaged, some years ago, in a process in which a large quantity of hydrogen gas was evolved, and having incautiously brought a lighted candle too near the apparatus, the whole exploded with a tremendous crash, and several twelve-gallon glass receivers were shattered into ten thousand pieces, and driven in all directions through the laboratory. Such accidents should be noticed, in order to inspire the young pupil with caution.

I remain yours, &c.,

W. Hopkinson, M. P. S.

LACCIC ACID.

The substance from which this acid is obtained, is collected in the neighbourhood of Madras. It was first described by Dr. Anderson, who says, that nests of insects, resembling small cowry shells, were brought to him from the woods by the natives, who eat them with avidity. These supposed nests he shortly afterwards discovered to be the coverings of the females of an undescribed species of coccus; and having noticed in Abbé Grosier's "Account of China," that the Chinese called a kind of wax, much esteemed by them, under the name of *pela*, from a coccus deposited, for the purpose of breeding, on certain shrubs, and managed exactly in the same manner as the Mexicans managed the cochineal insects, he followed the same process with his new insects, and found means to propagate them, with great facility, on trees and shrubs in the neighbourhood. This substance, which he called white lac, was found, on examination, to have a considerable resemblance to bees' wax. Dr. Anderson supposes, that the animal which secretes it, provides itself, by some means or other, with a small quantity resembling that produced by our bees. The sweetness of it tempted the children, who were employed to collect it, to eat so much of it, as very much to diminish his crop. A small quantity of this matter was sent to Europe in 1789. It was examined by Dr. Pearson, who published an account of his analysis in the "Philosophical Transactions" for 1794, from which we have extracted the information which we now lay before our readers.

A piece of white lac, which weighs from three to fifteen grains, is supposed to be produced by each insect. These pieces are about the size of a pea, of a grey colour, opaque, and roundish, but with a flat side, by which they adhere to the bark. In its dry state, white lac is soft and tough, and has a saltish and bitterish taste. A watery liquid, which has a slight salt taste, oozes out, on pressing a piece of this substance. White lac has no smell, unless it be pressed or rubbed, when it becomes soft, and then it emits a peculiar odour. When it is gathered from the tree, the pieces of lac are lighter than the bees' wax; but, after being melted and purified, it sinks in water. It melts in alcohol and in water at the temperature of 145°, and very readily in boiling water.

Dr. Pearson exposed 2000 grains of white lac to such a degree of heat, as was sufficient to melt them. They became soft and fluid, and there oozed out 550 grains of a reddish watery liquid, which emitted the smell of newly baked bread. The liquid was filtered and purified from extraneous matter: this liquid is laccic acid. It has a slightly saltish taste, with some degree of bitterness. It smells, when heated, like newly-baked hot bread. It reddens the tincture of turnsole. Its specific gravity, at the temperature of 60°, is 1.025. When this liquid remains for some time, at rest, it becomes turbid, and deposits a sediment. When it is evaporated, it becomes more turbid, and, allowed to remain at rest, it affords small needle-like crystals in mucilaginous matter. Two hundred and fifty grains of this liquor were exposed to heat in a small retort. As the liquor grew warm, mucilage like clouds appeared; but when it grew hot, they disappeared. At the temperature of 200°, it distilled over very fast. On distillation to dryness, a small quantity of extractive matter remained. The distilled liquor was transparent and yellowish, and, while hot, had the smell of newly-baked bread. Paper, stained with turnsole, which had been put into the receiver, was not reddened. One hundred grains of yellowish transparent liquid being evaporated till it became turbid, afforded, in the course of a night, circular

crystals, which had a bitterish taste. Under a lens, they appeared in a group somewhat resembling the umbel of parsley. One hundred grains of yellowish transparent liquid being evaporated in a low temperature to dryness, a blackish matter remained behind, which did not entirely disappear, when exposed to pretty strong heat; but, on heating oxalic acid to a less degree, it evaporated, and left no trace behind. From these properties, and from its peculiar action with alkaline, earthy, and metallic salts, Dr. Pearson concludes, that this acid is different from any of the acids already known. The experiments which have been made upon white lac and on the acid obtained from it, show that it is closely allied to the vegetable acids. Its component parts, therefore, probably are carbon, hydrogen, and oxygen; but experiments are still wanting fully to ascertain its nature and properties.

MISCELLANEA.

How to treat light Soils to the greatest Advantage.—Those who have acquired the reputation of good farmers do not invariably derive the greatest possible advantage from the land they cultivate; principally from their sticking too closely to some system or rotation of crops, which, in general practice, may be deservedly of high repute. This will more particularly apply to the management of light soils, and in those districts where the turnip system commonly prevails. Hence it is that we would venture to recommend partial and occasional departure from a rigid adherence to certain rotations of crops; because where this is carried out to the extreme limit, when a very unfavourable season occurs, there necessarily must be a great deficiency in one of the few general crops annually cultivated. Tares may be sown on the better sorts of light land after a good tillage, given immediately after harvest. If they be fed off or cut green in May or June, early turnips may be sown after them, which will be fit to feed off or draw for the cows in September, in good time for ploughing up the land for wheat sowing. In this case, the land gets all the ploughing necessary to clean it completely, and exactly at the best time. Three ploughings may be given after the tares, if the land be not clean; and the turnips being well hand-hoed and horse-hoed, the land will be perfectly clean to receive the wheat seed. Manure may be put on with the tares or the turnips; and if these be fed off with the sheep, they will so enrich the soil, that the next crop cannot fail to be abundant. By varying the management of light land according to circumstances, and with some judgment, many more profitable crops can be raised than by the common simple rotation, in which a fourth of the land is sown with turnips. If this crop fail, which is often the case where it recurs so often, the whole system is deranged, and the loss is very great. The introduction of a great variety of produce in the cultivation of light soils, in imitation of the Flemish practice, and the increase of stock kept in consequence, would be an important step in the improvement of British husbandry.

Proportion of Alcohol in different sorts of Intoxicating Liquors.—It is now generally known, that the intoxicating principle in wine and other fermented liquors, is alcohol. The proportion, therefore, entering into the composition of these liquors, has been ascertained with great nicety by Mr. Brand. The entire list would be too long for insertion, but the following will answer for all practical purposes:—

	Alcohol per cent.		Alcohol per cent.
Port (average)	23	Cider (average)	7½
Madeira	22¼	Perry	7¼
Sherry	19¼	Mead	7¼
Teneriffe	19¾	Burton ale	8¾
Lisbon	19	Edinburgh ale	6¼
Claret	15	Brown stout	6¾
Hock	12½	London porter	4¼
Burgundy	14½	Small beer	1¼
Champaigne	12½	Brandy	53¼
Tokay	9¾	Rum	53½
Currant wine	20½	Gin	51½
Gooseberry	11¾	Scotch whiskey	54¼
Orange	11¼	Irish ditto	54
Elder	8¾		

The following calculation will show two things—first, the great quantity of this liquid fire, which is annually consumed in the United Kingdom; and, secondly, that the greatest part of this is swallowed under the disguise of malt liquor:—

Allowing the average quantity in the different sorts of malt liquor to be 6 per cent., the quantity of pure spirit annually drunk in this country, in ale and porter, is about	25,380,000
In spirits, allowing the average to be 50 per cent.	12,963,080
In wine 20 ditto	1,193,108
The quantity of alcohol in cider, perry, and home made wines, it is supposed will exceed	2,000,000
	41,536,188

When it is recollected that alcohol is nearly double the strength of what is called proof spirit, do we need to be surprised at the amount of poverty, crime, disease, and death, annually produced by this forty-one millions of gallons of rank poison?—*Temperance Advocate.*

Explosion of Fire-damp.—We regret to say that, on the morning of Monday se'ennight, three persons were destroyed, and a fourth seriously injured, by an explosion of fire-damp in the marsh pit at Mostyn Colliery, Flintshire. The violence of the explosion was such, that one of the youths, named Davies, was literally blown to atoms, his skull being cleft in twain, and his limbs twisted and torn into threads, and scattered in every direction. William Jones and his cousin were immediately taken to their respective houses, but died during the day. Peter Thomas is not so seriously injured. It is impossible to record these dreadful and fatal occurrences, without speculating upon their cause. On the very face of the thing, it is clear that the colliers neglect the contrivance which science has invented for their safety; for had Sir H. Davy's lamp been made use of, the accident could not have occurred.—*North Wales Gazette.*

Consumption of Air by Man.—A middle-sized man consumes 46,000 cubic inches, or 26 cubic feet, or nearly a cubic yard of oxygen per day, making 20 respirations in a minute, and 1.62 cubic inch at each—that is, 46,659 cubic inches in 28,800 respirations per day. The nitrogen does not assimilate, and expires in combination with carbonic acid gas.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, July 20, Mrs. C. L. Balfour, on the Moral and Intellectual Influence of Woman. Friday, July 22, E. J. Hytche, Esq., on the Application of Phrenology to Education and Criminal Legislation. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Wednesday, July 20, Quarterly General Meeting. At half-past eight.

QUERIES.

If an "Amateur Mechanic" will forward a description of the apparatus for taking a facsimile of a medal in the lathe, he will greatly oblige. Cutting the form of a medal was my mistake. E. L.

1. Can any of your correspondents describe the geometric chuck? 2. How to test silver? 3. How to find the magnitudes of the sun and planets? 4. How is the sine 57′ 11″ found in measuring the moon's distance from the earth?
E. L.

How to clear ginger beer? I have tried the white of an egg, but it does not answer well. I have heard that the ginger-beer makers use lemon-juice for that purpose, with some addition to it, but cannot find it out. W. H.

What process does brass go through to make it appear of a dead pale yellow, as if frosted? Also, the cheapest and easiest way to braze brass like the braziers? Is it not done with borax and spelter? If so, what quantities, how to apply it, and at what shops can it be obtained? A. B.

Is there any known process for holding tin in solution? How is it prepared, and where can it be purchased? O. S.

Is there anything that will take varnish off a violin, as I have one that has been lately varnished, which has spoiled the tone of it? J. D.

If "S. A. J." has not met with a customer for his electrical machine, and money not being in immediate demand, I should be most happy to purchase, if it would suit him to allow me to pay for it at a shilling per week. A. B. C.

ANSWERS TO QUERIES.

Bellows are to be fixed, and, to supply the place of an aerometer—which has hitherto been worked by a common pair of bellows with manual labour—the machinery now required (which is to do away with the aerometer) must be of that construction, as to work the two pairs of bellows alternately for twelve hours; but will not the full of weight attached be too great, so as to preclude all possibility of the apparatus being placed in a room or kitchen? A small windmil will not apply. T. Jones.

To Construct a Magic Lantern.—Make a tin or wooden box, about eight inches in each of its dimensions, with a bent tin tunnel or chimney at top, to carry off the smoke of the lamp, which is in the middle. Furnish it with handles to carry it by, and with holes around and near the bottom, to feed the flame with the air necessary to its combustion. Leave one side of the box open, that the light may be managed. The lamp may be a common Argand burner, but furnished at the back with a concave reflector, to increase the intensity of the light. In the front of the box fasten a tin tube, having in it two lenses—a plano-convex lens, near the light, and a smaller double-convex lens, at the end of the tube farther off. The tube must be fastened to the lantern by a square foot, two sides of which are left open to admit the sliders. The double-convex lens should be made to slide in and out, that the focus may be properly adjusted.
R. M. Ordish.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.

No. 93, THIRD SERIES. | SATURDAY, JULY 23, 1842. | No. 341, OLD SERIES.

BUCHANAN'S PORTABLE HAND-DRILL.

FIG. 1.

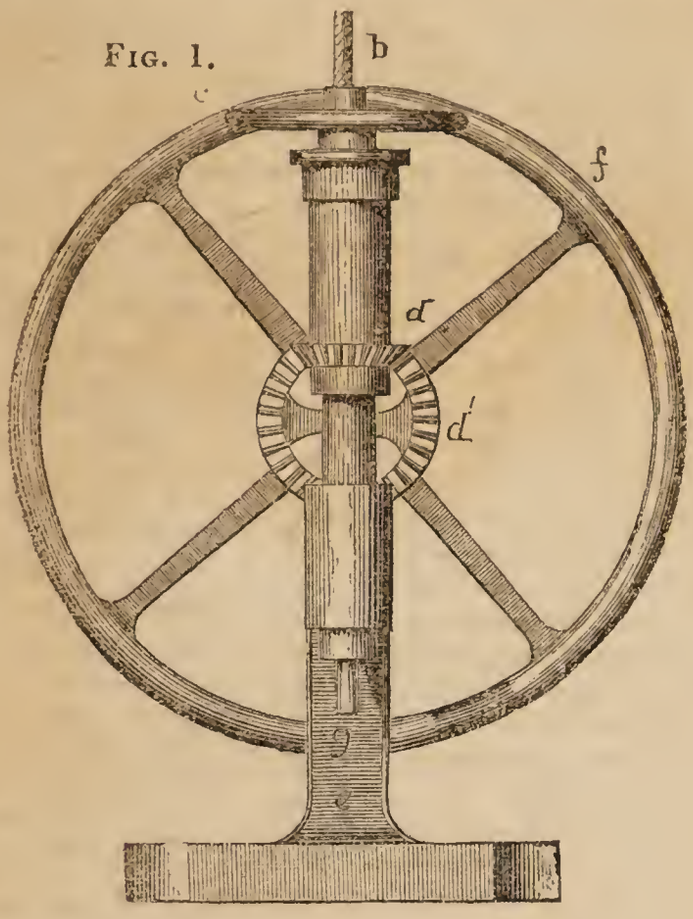
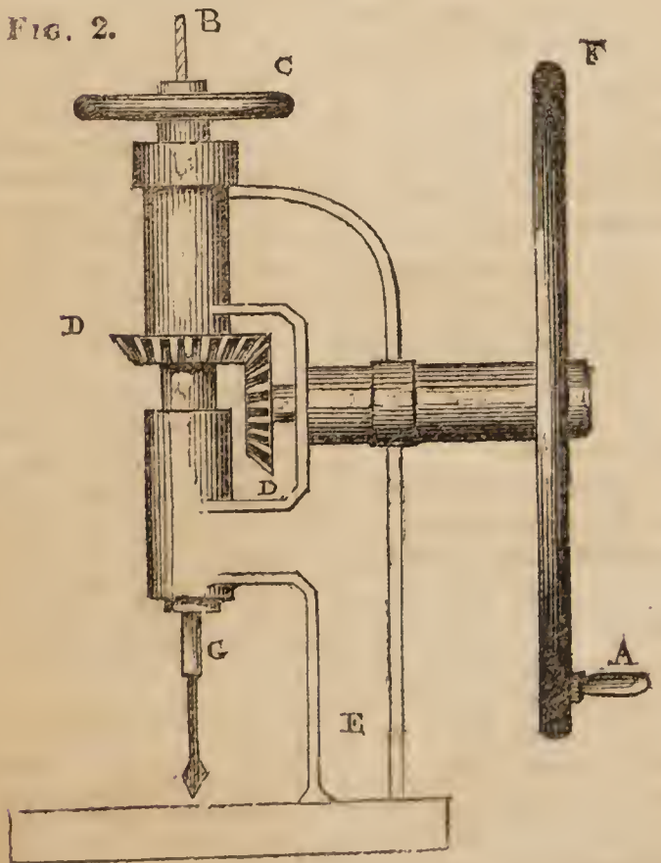


FIG. 2.



Vol. VIII.—No. 34.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney

BUCHANAN'S PORTABLE HAND-DRILL.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—In perusing the contents of a work styled "Buchanan on Mills and Machinery," I found a description of a "Portable Hand-drill," which will not only serve the purpose for any ordinary drilling, but certainly, for its convenience, ought to find a place in every amateur mechanic's workshop. If you think it worthy of insertion in your valuable Magazine, I think you will find it please your readers.

I remain yours, &c.,

H. H....r.

Description of the Engravings.

Fig. 1 is an elevation, and fig. 2 is a side view of the same. *e* represents the frame on which the whole is fixed; *g* is a vertical drilling spindle, to which the tool is fixed; *b* is a screw which is in connexion with a wheel, *c*, whereby the spindle and tool can be made either to descend or ascend, by turning the wheel; *d* is a bevel wheel, which is in connexion with another, *d'*, and which are made to revolve, by turning the handle, *a*, thereby communicating a revolving motion to the spindle, *g*. When it is required to be used, the handle is turned, and, by giving a motion gradually to *c*, the spindle is made to revolve and advance, and to drill a hole in anything that is placed in its way.

WATER LOCOMOTION.

To the Editor of the Penny Mechanic and Chemist.

Sir,—The advantages of life depending so much on water locomotion, I beg to submit some observations to the notice of your readers, hoping that the remarks may be found useful.

I remain yours, &c.,

Lewis Gompertz.

The speed of vessels in the water, as is well known, is affected by a very different and almost opposite law to that of carriages on land; the latter increasing in velocity more than in proportion to the power applied, while the velocity of vessels in the water does so much less; the resistance of the water increasing as the squares of the velocity; so that if 1 lb. be required to draw a vessel one mile in an hour, 4 lbs. will be required to draw it two miles in an hour, 16 lbs. to draw it four miles in an hour, and 1056 lbs. to draw it eight miles in an hour. This circumstance renders water-carriage much more fit for heavy weights with a slow velocity, than land-carriage, but very inferior for great speed. Still, by a proper adaptation of the shapes of the vessels, it appears that this difficulty can, in a great degree, be compensated. The chief impediment to the motion of vessels, when there is no tide, &c., is in the displacing of the water; and it follows from this, that it is only the breadth and depth of the vessel, and not at all its length, which causes the resistance; so that a vessel 1000 feet long, would move with the same ease—as far as the resistance of the water, which is the chief impediment, is concerned—as one of only one foot long. And this is not all: but the long vessel might, it appears, be so shaped, as to move even with much less force than the short one, which would be only 1-1000th part of its weight; because it could be made more of an acute angle, to meet the water, and the force required to displace a given quantity of water being governed by the angle of the body of the vessel.

It follows from this, that we have two great advantages in making vessels long: the first being, that we have a more extensive vessel moved by the same absolute power; and the second being, the offering the means of sharpening the angle, and thereby increasing the advantage.

It may appear absurd to conceive, that a long vessel does not displace more water than a short one; but only let it be borne in mind, that every vessel, during a voyage, displaces exactly so much water as is measured by the length of the voyage and the breadth and depth of the vessel; so that if the vessel be a yard wide and a yard deep, whatever be its length, and it travels 1000 yards, it will have made a furrow of 1000 yards long, and one yard square. All this quantity of water will then have been forced or raised out of its place, but with a facility which no other common mechanical means could at all approach, while the cavity is insensibly filled up by the incumbent fluid; and the ease with which the whole operation is performed, depends in so constructing the vessel, that the water gets transpose from the head to the stern with as little swell or rising as possible; and this depends on the acuteness of the prow, though, however acute this may be, it will force the water up into a hill before it, according to the velocity of the vessel.

It follows, then, that, if a steam-vessel

were made ten times as long as it now is, even a smaller engine would suffice to give it an equal speed with the former; and it farther follows, if the steam-engine were large in proportion, that very great speed might be obtained; and thus would the geometrical increase of the resistance be compensated by the increasing of the length of the vessel at pleasure, and thereby also increasing the effect of the power applied to a given size and weight of vessel.

It must be confessed, however, that vessels might be so long as to become insecure; but then another advantage might, it appears, be taken of the principle, which is, that a number of vessels might, perhaps, be so constructed, that one of them would communicate its motion to a number of others, without losing much of its own force; in order to effect which, the first vessel alone must have an angular prow, and the last one alone a stern; the intermediate vessels being made square or oblong, so as to fit each other, and the back of the front vessel, as well as the front of the back vessel, being made also flat, so as to fit them. These vessels, then, might be attached together merely by a rope, held by a man in each vessel, so that he could let it give way at pleasure. Motion, then, being given by the engine to the first vessel, would, if I am not mistaken, draw all the others after it in its wake. And it does not appear that the ropes attached from the vessels to each other would, excepting from accidental causes, and at the first setting off, ever suffer any tension; but, on the contrary, that the action of the first vessel might even cause all the others to press against it. Still it must not be inferred from this, that they would thereby add to its velocity, because they would only press themselves, instead of allowing the water to do so; it being the fact, that the stern of every vessel in motion is assisted by the water behind; and the knowledge of this fact, indeed, induced me some years ago to propose for the sterns of all vessels, instead of being angular, to be broad and concave, horizontally; having, as it appeared to me, found that the water, which was elevated by the action of the prow, ran round the vessel to the stern, and then, turning against the stern, assisted in propelling it; and I also proposed, that the sides of these vessels should be perpendicular, and the bottoms flat. (See Herepath's "Railway Magazine," No. 9, New Series, Nov., 1836, pp. 336 and 397; also, the "Mechanic's Journal," No. 6, vol. 1, for September, 1838, pp. 81 and 82, with plates.) When this plan was first proposed, it met with much opposition; but, after a long controversy, two of the persons who had originally opposed it, made experiments upon it, by means of models, and each of them found, that not only these vessels obtained some advantage over the best shapes in present use, but that they were also much more difficult to upset. It seems, then, to follow, that, by increasing the length of the vessel, by sharpening the prow, and by making the stern broad and concave, water locomotion may be greatly improved. There are, however, other impediments than the resistance of the water—such as friction and cohesion of the fluid against the vessel, so as to alter the effect in a degree; but these impediments seem very small.

CAUSES OF RAIN.

(Concluded from page 260.)

Since philosophers have admitted the electric fluid to such a large share in the operations of nature, almost all the natural phenomena have been accounted for by the action of that fluid; and rain, among others, has been reckoned an effect of electricity. But this word, unless it be explained, makes us no wiser than we were before; the phenomena of artificial electricity having been explained on principles which could scarce apply, in any degree, to the electricity of nature; and, therefore, all the solution we can obtain of the natural appearances of which we speak, comes to this—that rain is occasioned by a moderate electrification, hail and snow by one more violent, and thunder by the most violent of all; but in what manner this electrification is occasioned, has not yet been explained. The principles of electricity necessary to be attended to in the solution of the phenomena under consideration, are the following:—

1. The electric fluid and solar light are the same substances in two different modifications.

2. Electricity is the motion of the fluid when running, or attempting to run, in a continued stream, from one place to another—that is, when the fluid has no tendency but to vibrate outwards and inwards to and from a centre, or, at least, when its streams converge to a point or focus.

3. The fluid acting as electricity, like water or any other fluid, always tends to the place where there is least resistance.

On these three principles may the phe-

nomena of atmospherical electricity, and the descent of rain by its means, be explained, as follows:—

1. The light or heat of the sun, acting in that peculiar manner which we call *heat*, unites itself with the moisture of the earth, and forms it into vapour, which thus becomes specifically lighter than air, and, of consequence, ascends in the atmosphere to a certain height.

2. Besides the quantity of light which is thus united to the water, and forms it into a vapour, a very considerable quantity enters the earth, where it assumes the nature of electric fluid.

3. As the earth is always part of that fluid, every quantity which enters, must displace an equal quantity which is already there.

4. This quantity, which is displaced, must escape either at a distance from the place where the other enters, or very near it.

5. At whatever place a quantity of electric matter escapes, it must electrify the air above that place where it has escaped; and as a considerable quantity of light must always be reflected from the earth into the atmosphere, where it does not confine with the aqueous vapour, we have thence another source of electricity to the air; as this quantity must undoubtedly assume the action of electric fluid, especially after the action of the sun has ceased. Hence the reason why, in serene weather, the atmospherical electricity is always strongest, and rather more so in the night than in the day.

From these considerations, we see an evident reason why there must be commonly a difference between the electricity of the earth and that of the atmosphere, excepting where an earthquake is about to ensue. The consequence of this must be, that as the action of the solar light continues to bring down the electric matter, and the earth continues to discharge an equal quantity of it into the atmosphere, some parts of the atmosphere must, at last, become overloaded with it, and attempt to throw it back into the earth. This attempt will be vain, until a vent is found for the electricity at some other place; and, as soon as this happens, the electrified atmosphere begins to throw off its superfluous electricity, and the earth to receive it. As the atmosphere itself is a bad conductor, and the more so the drier it is, the electric matter attacks the small aqueous particles which are detained in it, by means of the latent heat. These, being unable to bear the impetus of the fluid, throw out their latent heat, which easily escapes, and thus makes a kind of vacuum in the electrified part of the atmosphere. The consequences of this are, that the aqueous particles, being driven together in large quantity, at last become visible, and the sky is covered with clouds; at the same time, a wind blows against these clouds, and, if there be no resistance in the atmosphere, will drive them away. But if the atmosphere all round the cloud be exceedingly electrified, and the earth be in no condition to receive the superfluous fluid—excepting in that place which is directly under that cloud—then the whole electricity of the atmosphere, for a vast way round, will tend to that part only, and the cloud will be electrified to an extreme degree. A wind will now blow against the cloud from all quarters; more and more the vapour will be extricated from the air by the electric matter, and the cloud will become darker and thicker, at the same time that it is in a manner stationery, as being acted upon by opposite winds, though its size is enlarged with great rapidity by the continual supplies of vapour brought by the winds.

ON

WARMING AND VENTILATION.

[*Abstract from the Report on the Apparatus erected in the Reform Club House, for Warming and Ventilating its several Apartments. By* Andrew Ure, M.D., F.R.S., Prof. of Chemistry.]

There are two general plans in use for at once diffusing heat, and renewing the air in extensive buildings, which plans differ essentially in their principles, modes of action, and effects. The oldest, and, what may be called, the vulgar method, consists in planting stoves in the passages or rooms, to give warmth in cold weather, and in constructing large and lofty chimney-stalks to draw air, in hot weather, out of the house, by suction, so to speak, whereby fresh air flows in to maintain, though imperfectly, an equilibrium of pressure. In apartments thus warmed and ventilated, the atmosphere is necessarily rarer than it is out of doors; while, in cold weather, the external air rushes in at every opening and crevice of door, window, or chimney—the fruitful source of indisposition to the inmates.

The evils resulting from the stove-heating and air-rarefying system, were, a few years ago, investigated by me, in a paper read before the Royal Society, and afterwards published in several scientific and technological journals. It is there said,

that the observations of Saussure and other scientific travellers in mountainous regions, demonstrate how difficult and painful it is to make muscular or mental exertions in rarefied air. Even the slight rarefaction of the atmosphere, corresponding to a low state of the barometer at the level of the sea, is sufficient to occasion languor, lassitude, and uneasiness in persons of delicate nerves; while the opposite condition of increased pressure, as indicated by a high state of the barometer, has a bracing effect upon both body and mind. Thus we see how ventilation, by the powerful draught of a high chimney-stalk, as it operates by pumping out, exhausting, and attenuating the air, may prove detrimental to vivacity and health; and how ventilation, by forcing air in with a fan or a pump, is greatly to be preferred; not only for the reason above assigned, but because it prevents all regurgitation of foul air down the chimneys—an accident sure to happen in the former method. Genial air thrown in by a fan, in the basement story of a building, also prevents the stagnation of vapours from damp and miasmata, which lurk about the foundations of buildings and in sewers, and which are sucked in by the rarefying plan. Many a lordly mansion is rendered hardly tenantable from such a cause, during certain vicissitudes of wind and weather.

The condensing plan, as executed by the engineers, Messrs. Easton and Amos, at the Reform Club House, consists of a large fan, revolving rapidly in a cylindrical case, and is capable of throwing 11,000 cubic feet of air per minute into a spacious subterranean tunnel under the basement story. The fan is driven by an elegant steam-engine, working on the expansion principle, of five horses' power. It is placed in a vault, under the flag pavement, in front of the building; and, as it moves very smoothly, and burns merely cinders from the house-fires, along with some anthracite, it occasions no nuisance of any kind. The steam of condensation of the engine, supplies three cast-iron chests with the requisite heat for warming the whole of the building. Each of these chests is a cube of three feet externally, and is distributed internally into seven parallel cast-iron cases (somewhat like empty portfolios), each about three inches wide, which are separated by parallel alternate spaces, of the same width, for the passage of the air transversely, as it is impelled by the fan. This arrangement is most judicious, economizing fuel to the utmost degree; because the steam of condensation, which in a Watt's engine would be absorbed and carried off by the air-pump, is here turned to good account, in warming the air of ventilation during the winter months. Two hundredweight of fuel suffices for working this steam-engine during twelve hours. It pumps water for household purposes, raises the coals to the several apartments on the upper floors, and drives the fan ventilator. The air, in flowing rapidly through the series of cells placed alternately between the steam-cases, cannot be scorched, as it is infallibly with air-stoves; but it is heated only to the genial temperature of from 75° to 85° Fahr., and it thence enters a common chamber of brickwork in the basement story, from which it is let off into a series of distinct flues, governed by dialled valves or registers, whereby it is conducted, in regulated quantities, to the several apartments of the building.

HISTORY OF MEDALS.

(Continued from page 261.)

Notwithstanding, however, this deficiency of gold coin among the Greeks, it is certain that the coinage of gold had taken place in Sicily long before; as we have gold coins of Gelo about 491 B. C., of Hiero I., 478, and of Dionysius I., in 404, all using the Greek characters; though not to be ranked among the gold coins of Greece, as Philip caused his to be. Gold coins of Syracuse even appear of the third class of antiquity, or with an indented square, and a small figure in one of its segments. Gold coins are used in the cities of Brettium, Tarentum, and throughout Magna Græcia; also in Panticapæa, in Thrace, and likewise Cosa, in that country; but not in Tuscany, as is commonly believed, though Neumann proves that they were struck by Brutus, and are, unquestionably, as ancient as the Greek coins. The Thebans and Athenians probably coined the first gold after Philip had set them the example, and when they were attempting to resist the projects of that enterprising monarch. The Ætolians probably coined their gold during the time of their greatest power, about a century after Philip, and when they were combating the power of Aratus and the Achæan league. Even in the time of Philip, gold was very scarce in Greece; but after the Phocians had plundered the Temple of Delphos, this precious metal, which had been valued as gems, and consecrated only to the decoration of the temples of the gods, began to be known among the Greeks. The comparative value of gold and silver, how-

ever, seem to have been at that time very different from what they are now. Herodotus values gold at thirteen times its weight in silver; Plato, in his "Hipparchus," at twelve; and even the low value of ten to one, seems to have been the stated value in Greece; though in Rome, the plenty of silver from the Spanish mines, made the value of gold to be much higher; and there is no reason to think that it was ever valued in that city at less than twelve times its weight in silver. The Philippus *χρυσος*, gold piece, or stater, is a didrachm, and is the most common of all the ancient coins. Mr. Pinkerton is of opinion that it went for twenty silver drachms on its first appearance; but in latter times, for twenty-five Greek drachmæ or Roman denarii. There are proofs of the Philippi being didrachms, both from the writings of ancient authors, and from numbers of the coins themselves, which remain to this day; and that the *χρυσος*, or principal gold coin of Greece, was of the same weight, is also evident from ancient writings. It was anciently worth about 15*s*., but valuing gold now at the medium price of 4*l*. per ounce, it is worth about 20*s*. The *ημιχρυσος*, or half the former coin, scarcely occurs of the coinage of Philip and Alexander, though it does of Hiero I., of Syracuse, and of King Pyrrhus. It passed for ten silver drachmas, and was valued only at 7*s*. 6*d*., though now worth 10*s*. There was another division of this kind worth about 5*s*. There were, besides, some lesser divisions of gold coins, which could not be worth above two drachmas. These were coined in Cyrene; and there were, besides, several old gold coins of Asia Minor, the value of which is now unknown. Our author supposes that they were coined, not with relation to their weight as parts of the drachma, but merely to make them correspond with so many silver pieces as was necessary. There are, also, larger coins than the *χρυσος*, the *διχρυσος* of Alexander and Lysimachus being double its value. Some others are met with of Lysimachus, Antiochus III., and some of the Egyptian monarchs, weighing four times the *χρυσος*, and now worth about 4*l*. sterling. Some weigh even more; but this, our author supposes, owing to a difference in the purity of the gold.

In Rome, as well as in Greece, the money was at first estimated by weight; and the first metal coined by that people was copper, silver being long unknown in Rome; nor is it certainly known that any silver has ever been found in the Italian mines. In Rome, the first valuation of money was by the *libra gravis æris*, or pound of heavy brass; and, in the progress of their conquests, the little silver and gold that came in their way, was regulated by the same standard, as appears from the story of Brennus. The weights made use of, were the same with those which continue to this day. The pound consisted of twelve ounces of 458 grains each; but the pound by which the money was weighed, appears to have consisted only of 420 grains to the ounce, or to have contained, in all, 5040 grains. This became the standard of copper; and when silver came to be coined, seven denarii went to the ounce, as eight drachms did in Greece. Gold was regulated by the scriptulum or scrupulum, the third part of a denarius, and by the larger weights just mentioned. The number ten, was at first used by the Romans in counting their money; but finding, afterwards, that a smaller number was more convenient, they divided it into quarters; and, as the quarter of ten is two and a half, they, for this reason, bestowed upon it the name of sestertius or "half the third;" to express that it was two of any weights, measures, &c., and half-a-third; whence the sestertius came at last to be the grand estimate of Roman money. The *as* being at first the largest, and, indeed, the only Roman coin, the word sestertius means *sestertius as*, or "two ases and a half."

MUTUAL-INSTRUCTION SOCIETIES.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Some time ago, you were kind enough to insert a letter in your Magazine, respecting the institution of a "Mutual-Instruction Society," at the West End. I am happy in being able to inform you, that our efforts have been successful. It must, Sir, I think, be gratifying to you to know, that your notice aided our cause; for which I now, in behalf of the Society, beg to return sincere thanks. Our place of meeting is at present at the schoolroom, John Street, Davies Street, Berkeley Square. We have had five or six interesting discussions and two lectures; the first lecture was on "Light," the second on "Phrenology." In conclusion,

I remain yours, &c.,

Benj. Poulson, Sec.

MISCELLANEA.

Experiments with the Air-pump.—Under the receiver of an air-pump, thoroughly exhausted, rare and dense bodies fall with equal swiftness. Most animals die in a minute or two, but some amphibia live hours. Frogs continue a long while, also adders, unaffected by the rarefaction of the air. An adder, nine days confined, exhibited signs of animation. Vegetation stops, combustion ceases, gunpowder will not explode, magnets are equally powerful, smoke descends, water and other fluids turn to vapour, glow-worms give no light, a bell sounds very faintly, and heat is slightly transmitted.

Lightning Conductors.—Closed windows are dangerous during lightning, because the inner side of the panes acquire an opposite electricity to the outside, and then any conducting body is likely to concentrate the action on the inside. Metallic bodies, picture-frames, coated mirrors, bell-wires, &c., display electricity, by induction, during a storm. The best lightning conductor is lead or copper, on the ridge of the roof, with perfect continuation of metal pipes into the ground.

The Average Temperature of the Winter Months in England, is about 40°, and of the summer months, 65°. Devonshire and Cornwall are about 4° warmer than London. In London, the mean annual temperature is 50.39°; at Edinburgh, 47°; and at Dublin, 49.4°. The 14th of January, on an average of years, is the coldest in the year.

Temperature of Coal Mines, &c.—The deepest coal mine in England, is at Killingworth, near Newcastle, and the mean annual temperature, at 400 yards below the surface, is 77°, and at 300 yards, 70°; while at the surface it is but 48°; being about 1° of increase for every fifteen yards. This explains the origin of hot springs, for, at 3300 yards, the heat would be equal to boiling water, taking twenty yards to a degree. The heat of the Bath waters is 116°, hence they would appear to rise 1320 yards. By experiments made at the Observatory of Paris, fifty-one feet depth corresponds to the increase of 1° Fahr. Hence, the temperature of boiling water would be at 8212 feet, or about one mile and a half English, under Paris.

Arctic Regions.—Spring is the most rapid in the Arctic regions. The snow disappears, and birds of passage re-appear. Then, within a few days, the trees burst into foliage, the ground is covered with flowers, and mosquitoes are thawed into millions, which, with horse-flies, sand-flies, &c., render summer less comfortable than winter. Spiders, frogs, fish, &c., frozen, and as brittle as ice, revive with the thaw.—*Phillips.*

Effects of Machinery where Trade is Free.—The immediate and certain effect of good machinery, is an increase of production. It is said, that he that makes two blades of grass grow where only one grew before, is a benefactor to his race. Is not he who can produce cloth for five suits of clothes, where only one was produced before, equally a benefactor? The tendency of this increase of production is, to cheapen the price. It is said, it would require 150 men to grind as much corn in the hand-mill in one day, as can be ground in an ordinary water-mill; and if the ruder machinery of breaking the grain by stones were adopted, perhaps it would require 500. Who does not see by this, that the price of the article would be vastly increased? If machinery were abandoned in the whole process of procuring and transmitting coals, instead of 10*s.* per ton, they could not be had for 10*l.* per ton. What is it that has so immensely diminished the value of needles, tape, books, silk, cotton, but the introduction of improved machinery? The obvious effects, then, of machinery, are abundance and cheapness, and these must be regarded as great blessings. A double harvest would be considered as a merciful dispensation of Providence; and why not a double harvest of clothing which the people need, and any portion of which, but for bad laws, could be exchanged for food? Such an increased consumption is sure to follow cheapness of price, and will lead to the employment of an additional number of hands.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, July 27, S. Webbe, Esq., on the National Music of Wales, Ireland, and Scotland. Friday, July 29, E. J. Hytche, Esq., on the Application of Phrenology to Education and Criminal Legislation. At half-past eight precisely.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, July 25, Mr. Baker, on Chemistry. At a quarter-past eight o'clock.

QUERIES.

What stain is used by chair-makers for staining chairs? A. M.

The most simple method of gilding picture-frames in plain and burnished gold; or what

work gives the desired information on the subject; most books giving the process of mixing the ingredients, instead of laying on the gold?

A. M. L.

Can any of your correspondents inform me the addresses of Professors Faraday and Daniell?

I. J. P.

What is the bleaching composition, and how applied, to render the boot-top so snowy white? Through what process do gun-barrels pass, to give that watery mark upon them, commonly called the "sham or mock twist?" Also, what is considered the best application for removing fruit stains, iron moulds, &c., from linen? W. W.

The characteristic tests of copper, lead, and iron, in solution? Also, the method of separating these metals when they occur together?

A. C. R.

"H. J. Budd" will much oblige me by stating how the mixture for preserving the skins of animals is to be applied along with the tow inside, or a solution to be made, and the skins immersed therein. Also, the varnish used by grainers in finishing their work. B. G.

What are dies for medals, &c., engraved in? Where can I procure a manual of lithography, and under what title; a box of body colours for flower painting; a medallion-engraving machine, and what price? UTILE.

How to construct the teeth of cog-wheels, so that there may not be half-a-tooth? J. WATSON.

The new mode of dyeing black, as practised by the French? W. W.

A description of the double bellows for glass-blowing, so that I can make them; for I have a good blowpipe, but cannot keep up a steady blast long enough; or if they are made for sale by any one, where can I get them; also the price, &c., so that they may be forwarded to me in the country, by my giving a post-office order?

J. SOULBY.

Being about to construct a Daniell's battery, each cell of which is to contain 200 square inches of surface—that is, the zinc plate is to be ten inches square, placed in a flat porous jar an inch wide, with copper plates on each side of it of the same dimensions—I shall feel obliged if any of your correspondents will inform me how many of these cells will be sufficient to produce the voltaic light with charcoal. Also if they can inform me of any other better construction of the Daniell's battery to produce the same effect, and how many of a Smee's six-inch square will effect the same. J. D. S.

In a factory where I am employed, many small articles are made—such as tacks, buckles, &c., all of which are made of iron—which are now tinned in the old way—that is, after being properly prepared, are dipped in melted tin. Now it strikes me, a great improvement might be made, by dipping such articles in a solution containing tin or its oxide; somewhat after the manner that articles are made to receive a coating of gold or silver. By any method such as this, I believe they would be much clearer, less expensive, not liable to clog or stick together, and be done in less time. I have tried a few experiments, and have succeeded in giving them a coating of copper, but have not been able, at present, to give them a coating of tin by any new process. I have very little time to call my own, but think there may be some known method for producing the above result, and shall be glad if any of your correspondents can give a little information on the subject.

W. S.

ANSWERS TO QUERIES.

To make Fumigating Pastiles. — Benzoin, ½ oz.; Peru, nitre, of each 1 oz.; oil of nutmeg, oil of cloves, of each 2 drachms; charcoal, 1 lb.; bergamot, 1 drachm. Mix the ingredients together to a paste, and form them in the shape of a cone. B. G.

I beg to inform your correspondent, "J. W." that the atmospheric air is not entirely excluded from the surface of the steel in the process he mentions. Any substance, when merely clamped by screws, cannot be considered as being in actual contact; so that, however firm it may be fixed, there is still a stratum of air between them, which is quite sufficient to produce the usual blue colour. A. TAYLOR.

TO CORRESPONDENTS.

A. Taylor.—*We must decline inserting his letter respecting the cause of blue on steel, as well as any other on the same subject. The controversy arises more from a misunderstanding of each other, than from any error in judgment; and it would, therefore, be unprofitable to continue it.*

W. S.—*The notice in a former Number referred to another correspondent bearing the same initials. We have not received his first letter, but have inserted the substance of this in the list of Queries.*

S. M. Andrews.—*We cannot at present promise to give insertion to his communication; the subject requires a great deal of mature deliberation. We will, however, take care not to lose sight of it, and will give it our earliest attention.*

A Friend to Mechanics.—*We always feel compelled to set our faces, as a flint, against the system advocated by this correspondent; and without attempting to enter into a controversy on the subject, will at once pronounce our firm and certain conviction that, if carried out, it must be utterly destructive of everything which preserves good order in society. We very much question if he be in reality what he professes to be in name.*

ERRATA.—In the article on "Hooks and Eyes to Lathe Bands," page 250, both of them must be hooks, and must be made of soft iron, and bent after the gut is in them, otherwise it will be almost impossible to get it in. The article in the same Number, signed "A. S." should have been "L. G."

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

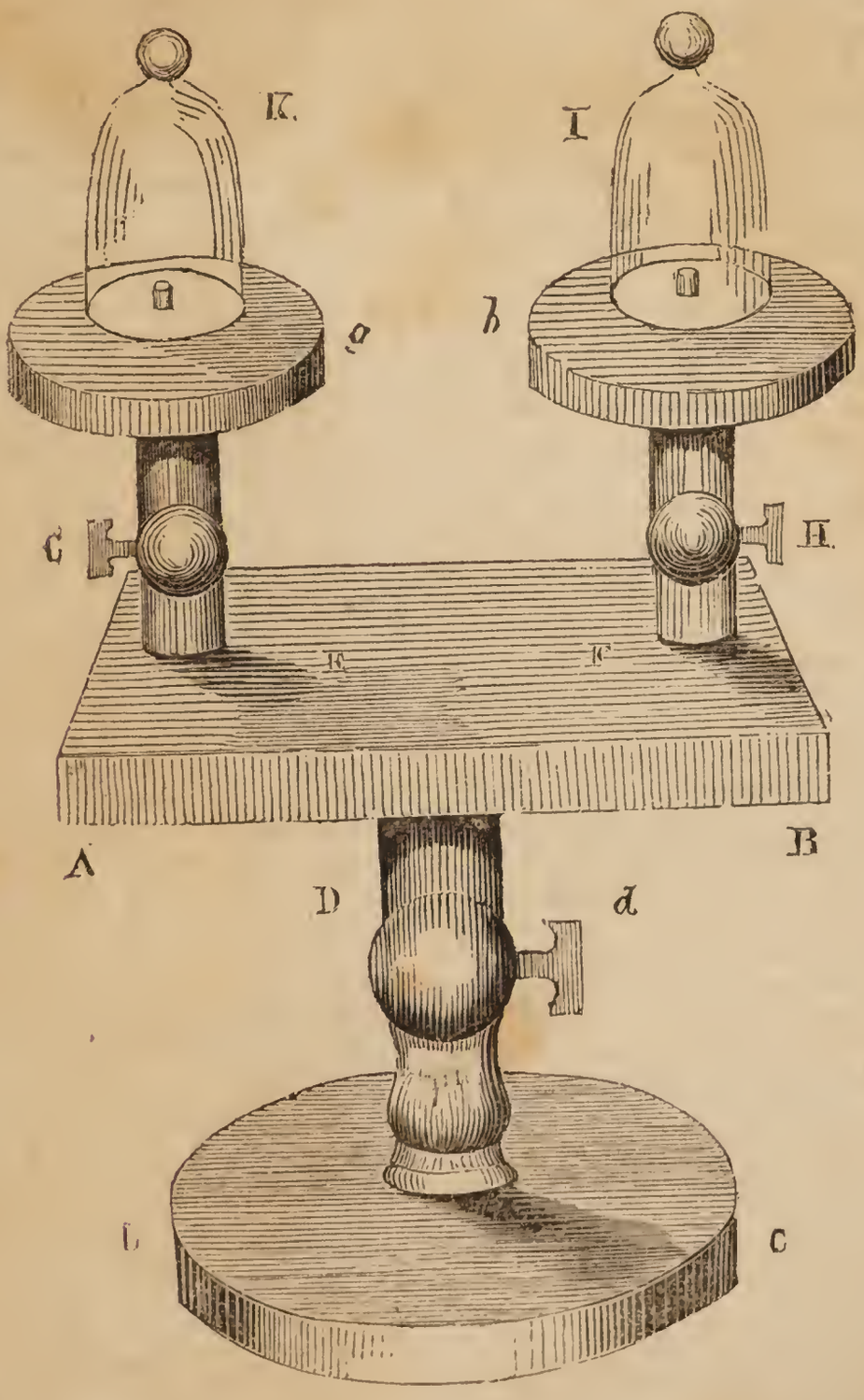
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 94, THIRD SERIES. | SATURDAY, JULY 30, 1842. | No. 342, OLD SERIES.

APPARATUS FOR PNEUMATIC EXPERIMENTS.



Vol. VIII.—No. 35] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

PNEUMATICS.

No. VI.

(See Engraving, front page.)

Experiment 8.—Screw the end, C, of the pipe, C D, into the hole of the pump plate, and turn all the three cocks, *d*, G, and H, so as to open the communication between all the three pipes, E F, D, C, and the hollow trunk, A B; then cover the plates, *g* and *h*, with wet leathers, which have holes in their middle, where the pipes open into the plates, and place the close receiver, I, upon the plate, *g*. This done, shut F, by turning the cock, H, and exhaust the air out of the receiver, I; then turn the cock, *d*, to shut out the air; unscrew the machine from the pump, and, having screwed it to the wooden foot, L, put the receiver, K, upon the plate, *h*. This receiver will continue loose on the plate as long as it keeps full of air, which it will do, until the cock, H, be turned to open the communication between the pipes, F and E, through the trunk, A B; and then the air in the receiver, K, having nothing to act against its spring, will run from K into I, until it be so divided between these receivers, as to be of equal density in both; and then they will be held down with equal forces to their respective plates, by the pressure of the atmosphere; though each receiver will then be kept down with only one-half the former pressure which it had when it was exhausted of air, because it has now one-half of the common air in it which filled the receiver, K, when it was set upon the plate; and, therefore, a force equal to half the force of the common air, will act within the receivers, against the whole pressure of the common air upon their outsides. This, and the following experiment, will show the elasticity or spring of the air.

Experiment 9.—Put a cork into a square phial, and fix it in with wax; put the phial upon the pump-plate, with a small wire cage over it, and cover the cage with a close receiver; then exhaust the air out of the receiver, and the air that was corked up in the phial, will break the phial outwards by the force of its spring; because there is no air left on the outside of the phial, to act against the air within it.

Experiment 10.—Put a shrivelled apple under a close receiver, and exhaust the air out of it; then the spring of the air within the apple will pump it out, so as to cause all the wrinkles to disappear; but upon letting the air into the receiver again, to press upon the apple, it will instantly return to its former decayed and shrivelled state.

Experiment 11.—Take a fresh egg, and cut off a small portion of the shell and film from its smallest end, and then put the egg under a receiver, and pump out the air; upon which, all the contents in the egg will be forced out into the receiver, by the expansion of the bubble of air contained in the great end between the shell and film.

G. STARKEY,
Mineralogical Chemist.

DIRECTIONS OF ROADS AND STREETS.

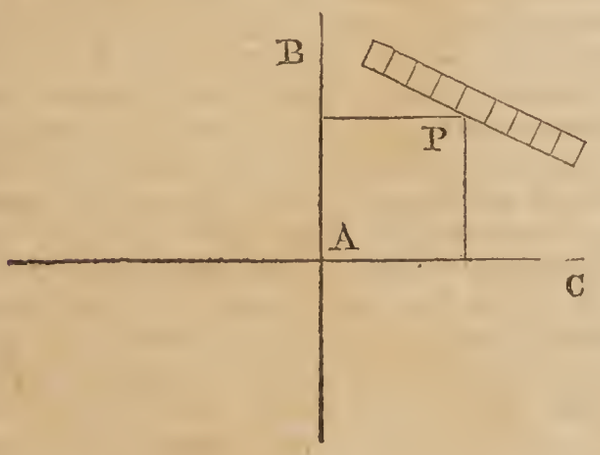
To the Editor of the Penny Mechanic and Chemist.

SIR,—It is certainly a matter for wonder, that, among all the great improvements of the present time, no attention seems to be paid to the directions of roads and streets, which appear to have been formed by private interests, without regard to the public good; running in all directions at random: so that, excepting the roads leading to and from London and other principal towns, communication can only be carried on by the most circuitous and uncertain courses; the cross roads being so intricate and indirect, that, in many parts, it is better to go ten miles from a village to London, &c., and then proceed to another village a couple of miles distant from the former, than to go directly from village to village. This, indeed, requires improvement, as does also the mode of identifying places, roads, and streets. The evil relating to roads cannot be easily remedied, excepting where towns are in their infancy; but in such places as New South Wales, it might be done by the following plan:—As soon as a town is being formed, let all the roads emanate from its centre in lines, and let all the cross roads be concentric; but when these radii diverge too much from each other, let them be intersected by another radius; another again, when the latter distance between the last two radii becomes too great; these radii being numbered—say from one to thirty. By this plan, then, a traveller might go from one village to another, without going much out of his way, and would always know his way without any names to the roads; as he would only have to ascertain which circle and radius he was in or near, and then he would know enough. Suppose, for instance, he wanted to go to Bath, and Bath was situated in or near the eighth ring, and near the thirtieth radius, he would then only have to keep this in mind. And he might even

ascertain his distance from the central town, &c., by measuring the curvature of the circular road; and, by means of a mariner's compass, he might also discover what part of the circle he was in. This map, then, would exactly resemble a spider's web, excepting where the wide distances were intersected.

Some difficulty would arise if the plan were independently adopted by two distant towns; as, when the roads approached others, each emanating from different centres, a space must be left between the roads of each town, which could not come in the boundary of either; but such spaces would not at any rate be worse off than they are at present.

A remedy to the second evil has also been many years previously suggested by Benjamin Gompertz, Esq., and might, with great advantage, be immediately applied to London itself. He proposes to do away with the names of streets, as well as the numbers to houses, and, instead of this, for every house to be marked according to its actual latitude and longitude, so that their situations could be found in a moment without any inquiries. His proposal for the map of a city is as follows:—



Draw two lines, A B and A C, perpendicularly to each other; the one, A B, from north to south, the other, A C, from east to west; each to be divided in equal parts, representing some small measure—as 100 feet or 100 yards, &c., as may be agreed on—to be denominated city degrees; these to be divided into 100 parts, called city minutes, and so on for smaller divisions. The point, A, from whence these measures are to be taken, should be some principal point—say the centre of the city. The measure on A B to be called the latitude north or south, according to which side of A it lies; and that on A C, the longitude, east or west, according, also, to which way it lies. A survey should be taken of the city, and the measure from those lines should be taken to every house, P; giving what would be called the city latitude and city longitude of that house; and should be affixed on the house in lieu of a number. It might be necessary to enter more fully in detail, if this plan were adopted; but, for the present, this description may suffice; observing that the street should be named by the latitude and longitude of some point in it, by a plan which may be easily explained.

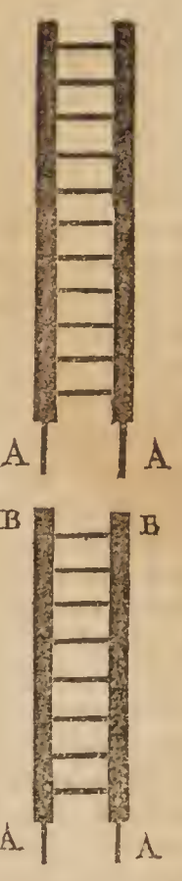
I remain yours, &c.,

LEWIS GOMPERTZ.

FIRE-LADDERS.

To the Editor of the Penny Mechanic and Chemist.

SIR,—Having observed, in many of the Numbers of your Magazine, several inventions of fire-escapes, I have been led to think upon the subject of fire-ladders; most essential and serviceable things in such a large city as this, as well as in country towns. You will, therefore, oblige me by inserting the following suggestion of an improvement upon the fire-ladders now so commonly used in many parts of the parishes in London, which has most likely been noticed by some of your readers. The plan is as follows:—



a a are two iron bars, about an inch and a quarter in diameter, which slide into the two holes, *b b*; and so on, in succession, to any length that the case may require. This, I think, will be found to be much stronger than the present system.

I remain yours, &c.,

F. H. P.

CAUSES OF RAIN.

(Continued from page 268.)

THE vapours which were formerly suspended invisibly, by means of the latent heat, are now suspended visibly, by means of the electric fluid, which will not let them fall to the earth, until it is in a condition to receive the electric matter descending with the rain. It is easy to see, however, that thus everything is prepared for a violent storm of thunder and lightning, as well as rain. The surface of the

earth becomes electrified from the atmosphere; but when this has continued for some time, a zone of earth, considerably below the surface, acquires an electricity opposite to that of the clouds and atmosphere; of consequence, the electricity in the cloud, being violently pressed on all sides, will, at last, burst out towards that zone where the resistance is least, as is explained under the article lightning. The vapours, now having lost that which supported them, will fall down in rain, if there be not a sufficient quantity of electric matter to keep them in the same state in which they were before: but if this happen to be the case, the cloud will instantly be charged again, while little or no rain will fall; and hence very violent thunder will sometimes take place without any rain at all, or such as is quite inconsiderable in quantity.

When the electricity is less violent, the rain will descend in vast quantity, especially after every flash of lightning, and great quantities of electric matter will thus be conveyed to the earth; insomuch, that sometimes the drops have been observed to shine as if they were on fire; which has given occasion to the reports of fiery rain having fallen on certain occasions. If the quantity of electric matter be smaller, so that the rain can convey it all gradually to the ground, there will be rain without any thunder; and the greater the quantity of electricity, the more violent will be the rain. From this account of the causes of rain, we may see the reason why, in warm climates, the rains are excessive, and, for the most part, accompanied with thunder; for there the electricity of the atmosphere is immensely greater than it is with us. We may also see why, in certain places, according to the situation of mountains, seas, &c., the rains will be greater than in others, and, likewise, why some parts of the world are exempted from rain altogether. But, as a particular discussion of these would necessarily include an explanation of the causes and phenomena of thunder, we shall, for this reason, refer the whole to be treated of under that article.

Whether this theory be just, however, it would be too assuming in us to say. It may admit of dispute; for we must grant, that, in the very best of systems, though an occurrence so frequent, the theory of rain is but very imperfectly understood. Dr. Hutton, whose speculations are always ingenious, though generally extraordinary, and much out of the common way, has given a new theory of rain in the first volume of the "Transactions of the Royal Society of Edinburgh." It is well known that atmospheric air is capable of dissolving, with a certain degree of heat, a given quantity of water. The Doctor ascertains the ratio of the dissolving power of air in relation to water in different degrees of heat, and shows that, by mixing a portion of transparent humid warm air with a portion of cold air, the mixture becomes opaque, and part of the water will be precipitated; or, in other words, the vapour will be condensed into rain. The ratio which he states, however, does not appear to us to be supported by experience. Whether the electricity of the air changes in consequence of its depositing the water dissolved in it, or the change is a cause of this deposition, must remain uncertain; but in either view, there must be an agent different from heat and cold, since the changes in these respects do not, in other operations, change the state of electricity. Dr. Hutton supposes, that heat and solution do not increase by equal increments, but that, in reality, if heat be supposed to increase by equal increments along a straight line, solution will be expressed by ordinates to a curve, whose convex side is turned towards that line. That the power of solution is not increased in the mere ratio with heat, is, however, hypothetical; except when we rise pretty high in the scale, when its proportional increase is a little doubtful; and it is not in this paper supported by experiment. The condensation of the breath in air, is not an observation in point, except in air already saturated with vapour. It can amount, in any view, to no more than this—that, to render it visible, the heat must be diminished in a greater proportion than can be compensated by the power of solution in the body of air in which the portion expired is at first immersed. To explain rain from this cause, we must always suppose a constant diminution of heat to take place at the moment of the condensation of the vapour; but we actually find, that the change from a state of vapour to the fluid state is attended with heat; so that rain must at once oppose its own cause, and continued rains would be impossible, without calling in the aid of other causes. From his own system, Dr. Hutton endeavours to explain the regular and irregular seasons of rain, either respecting the generality of its appearance, or the regularity of its return. And, to obviate the apparent exceptions of the theory from the quantity of rain, he explains the proportional quantities of rain, and adds a comparative estimate of climates in relation to rain, with the meteorological observations made in

our own climate. As his principle is, at least, insufficient, and, we think, erroneous, it would be useless, even were this a proper place for it, to pursue these various branches, which must partake of the errors of the system. In these branches we ought to observe, that there are several just observations mixed with errors; because evaporation and condensation must, at least, be the grand basis of every theory he undertakes, and not from not being aware of all the causes, and misrepresenting the operation of those which do exist.

(To be continued.)

EXPERIMENTS AT WOOLWICH DOCKYARD.

The Lords of the Admiralty, and several of the head officers of the Dockyard, at Woolwich, witnessed, last week, the exhibition of an invention by Captain Smith, R.N. (the inventer of the paddle-box boats), for extinguishing fires, and, at the same time, answering the purpose of affording facilities for the descent of persons from a height up to about sixty feet, when in danger from fire. This invention consists of a carriage upon four wheels, similar in dimensions to those used for the common fire-engine. The carriage is about twelve feet long by six feet broad, in the centre of which is raised a hollow mast, about twenty-five feet high, on the outside of which, pieces of wood are attached to form a ladder, which may be ascended with the greatest ease, even by persons not much experienced in climbing. From the centre of the mast another is raised, of smaller dimensions, extending the height to about fifty feet. A cross beam, about twenty-five feet in length, similar to the cross yards of a square-rigged vessel, having a leathern hose, with the conducting pipe, attached to one end, was raised, in less than two minutes, by five men, by the simple aid of a rope and pulley, to the height of the masthead, and the whole direction of the apparatus was effected by the strength of four men; proving, when the force of two fire-engines, worked by ninety-six men, was applied, that an immense volume of water could be discharged in a body, at any height up to ninety feet, and with such precision as to insure that it would soon extinguish any fire, and almost under any circumstance that could occur, when that devouring element obtained the ascendency. The experiments with this invention were repeated several times, and another engine was worked in the usual manner, to show that the volume of water thrown up by it lost, in a manner, its effect at a height of about thirty feet, the water spreading into the form of a heavy shower of rain at a higher elevation. By Captain Smith's plan, the conducting pipe, with the water emanating from it in a body, could be conveyed through a window into the interior of a burning building. When not in use, the mast is lowered to a horizontal position, in the same manner as the funnels of steam-boats when proceeding under many of the low-arched bridges; and it rests on an iron support, when conveyed from its station to the spot where its services may be required. Mr. Braidwood, of the fire-engine department, was present during the whole time, and appeared to approve of the invention.

Their Lordships then proceeded to the testing-room, where one of Porter's anchors, of 60½ cwt.—the largest ever made on that principle—was standing in the testing-frame, their lordships being desirous to witness, personally, this interesting process on that peculiar anchor. On the hydraulic pressure of Bramah's powerful machine being applied to the extent of 49½ tons—the usual test for anchors of the same weight—the deflection of the shank was found to be rather more than an inch, which was considered so little, that the patentee stated he had no objection to an additional strain of ten tons being applied. The order being given, the additional power was applied, and, notwithstanding the immense strain of 59½ tons, the whole deflection did not exceed one inch and seven eighths; proving that the anchor of 60½ cwt., sustained a test which would have been considered perfect, had it been one of 82 cwt., on the common principle. Their lordships seemed highly gratified with the result of the strength of this anchor; and especially to observe, when the power was withdrawn, that the deflection returned to within half-an-inch of the original state of the shank before the test commenced. An anchor of this weight is generally used on fifty-gun frigates; but the result of the test has shown, that it would be sufficient for ships of ninety guns.

Heat.—The motion of heat does not pass through bodies, till it has put their atoms in uniform motion. Some bodies are more susceptible, or contain more susceptible atoms than others. Silver and gold, copper and tin, are among bodies the most susceptible of atomic excitement, and conduct heat the best; other metals have less facility, stones less than metals; brick, glass, dried woods, and charcoal less still; feathers, silk, wool, and hair, least of all bodies.

ELECTRICAL EXPERIMENTS.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Perhaps the following may amuse, as well as instruct, those of your readers who are fond of electricity as a science:—

1st. Take a bit of wool or cotton, or a few very light downy feathers; lay them upon the palm of your hand, at the same time holding the hand four or five inches from the prime conductor; turn the machine, and the cotton or feathers will fly to the prime conductor, and from the conductor to the hand, with a very quick motion, and continue as long as the machine is turned. The prime conductor, being strongly electrified, attracts the unelectrified cotton or feathers, and electrifies, then repels, them to the nearest conductor—that is, the hand; there the cotton or feathers deposit electricity, and are again attracted by the prime conductor.

2nd. Let a person, standing upon the insulated stool, take a piece of money between his teeth; and if a person, standing upon the ground, touch the money, the spark will be so painful to the person who holds the money, that he seldom fails to let it drop, provided his lips do not touch it at the same time.

3rd. Take two slips of common window-glass, about four inches long and one inch broad; put a slip of gold leaf between the glasses, leaving a small part of it out at each end; then tie the glasses together, or press them with a heavy weight, and send the charge of a battery through it, by connecting one end of the glass with the outside of the jars, and bringing the discharging rod to the other end, and to the wires of the inside of a battery. The gold leaf will be forced into the pores of the glass, so that it will appear like glass stained with gold, which nothing can wash away. If the gold be put between two cards, and a strong charge passed through it, it will be completely fused or melted; the marks of which will appear on the card.

4th. Lay a chain over a sheet of writing-paper, and send the charge of the battery through the chain, and you will see black marks will be left on the paper in those places where the rings of the chain touch each other.

I remain yours, &c.,

W. Hopkinson.

(To be continued.)

HISTORY OF MEDALS.

(Continued from page 270.)

On the first coining of silver, the denarius of ten ases was struck in the most common and convenient denary division of money, or that by tens; the sestertius being, of course, two ases and a half; but the denarius, being afterwards estimated at sixteen ases, the name sestertius was still applied to a quarter of the denarius, though it now contained four ases. The term sestertius was applied to all sums not exceeding 1000 sestertii, or *8l. 6s. 8d.*; but for greater sums, the mode of the sestertius was likewise altered, though not to exclude the former. Very large sums of money were estimated by the hundred weight of brass; for the Romans were, at first, unacquainted with the talent. The hundred weight, by way of eminence, was distinguished by the name of pondus, and sestertium pondus became a phrase for two hundred weight and a half. Mr. Pinkerton is of opinion, that we may value the as libralis of ancient Rome, at *8d.* English. Estimating the *as*, therefore, at a pound weight, the sestertium pondus was equal to 1000 sestertii, or *8l. 6s. 8d.*; and, by coincidence, which our author supposes to have been the effect of design, as soon as the silver coinage appeared, the sestertium centum denariorum was always equal to *8l. 6s. 8d.* also. The word sestertium itself, however, seems to have been unknown prior to the coinage of silver money at Rome: the pondera gravis æris being sufficient, before that time, for all the purposes of a state in which money was so scarce. But, however this may be, the pondus or hundred weight of brass, was precisely worth 100 denarii, or a pound of silver. As the great sestertium was always valued at 1000 of the smaller, or *8l. 6s. 8d.*, we never find one sestertium mentioned in authors, but two, three, or more; 10,000 of them being equal to *83,333l. 6s. 8d.*

The states from which the Romans may be supposed first to have derived their coinage, were the Etruscans and the Greek colonies in Magna Græcia and Sicily. Joseph Scaliger, Gronovius, &c., contend, that it was from the Sicilians that the Romans first derived their knowledge of money; but Mr. Pinkerton argues that it was from the Etruscans. In confirmation of his opinion, he appeals to the state of the Roman territories in the time of Servius Tullius, who is looked upon to have been the first who coined money at Rome. At that time, the whole Roman dominion did not extend beyond

ten miles round the city; and was entirely surrounded by the Etruscan and Latin states; Cumæ being the next Greek colony to it that was of any consequence, and which was in the neighbourhood of Naples, at about the distance of 150 miles. Our author asks, "Is it reasonable to think that the Romans received the use of money from the Etruscans and Latins, who were their neighbours, or from the Greeks, who were at a distance, and, at that time, as far as appears from their history, absolutely unknown to them? If this argument," adds he, "be strong with regard to the nearest Grecian colonies, what must it be with respect to Sicily, an island 300 miles distant from Rome, where it was not known at that time, if a boat went by land or water?" Arguments, however, for this opinion, have been derived from the similarity betwixt the Sicilian and Roman coins; which Mr. Pinkerton now proceeds to examine. The Greek pound in Sicily was called λιτρα, and consisted, like the Roman, of twelve ουγκιαι, or ounces; and Mr. Pinkerton grants that the Roman libra was derived from the Greek λιτρα, but denies that the *as*, or libra, a coin, was from Sicilian model. The Sicilians had, indeed, a coin named λιτρα; but it was of silver, and of equal value to the Æginean standard, ten of which went to the Sicilian δεκαλιτρα. He differs from Gronovius, that the standard of Ægina was used at Corinth, and, of course, at Syracuse; and it appears from Aristotle, that the Sicilians had a talent or standard of their own. The Sicilian obolus or λιτρα, contained, also, twelve ounces or chalci, so named, at first, because they weighed an ounce weight; but the ουγκιαι of Hiero, weigh more than a troy ounce; and the brass coins of Agrigentum are marked with cyphers as far as six; the largest weighing only 186 grains, or about one-third of the primitive ounce. Our author denies, that even the Roman denarius took its rise from the Sicilian δικαλιτρον, as many authors assert. Were this the case, it would have weighed 180 grains; whereas the Roman denarii are not above the third part of the quantity.

From all these considerations, our author is of opinion, that the Sicilians borrowed the division of their λιτρα from the Etruscans, or, possibly, from the Romans themselves; which our author thinks is more probable than that the Romans had it from Sicily. The strongest argument, however, against the Roman coinage being borrowed from the Sicilian is, that though great numbers of Sicilian coins are to be found in the cabinets of medalists, yet none of them resemble the as libralis of the Romans in any degree. In most cabinets, also, there are Etruscan coins upon the exact scale of the as libralis, and several of its divisions; from whence Mr. Pinkerton concludes, that "these, and these alone, must have afforded a pattern to the primitive Roman coinage." The Etruscans were a colony from Lydia, to which country Herodotus ascribes the first invention of coinage. "Those colonists," says Mr. Pinkerton, "upon looking round their settlements, and finding that no silver was to be had, and much less gold," supplied the mercantile medium with copper; to which the case of Sweden is very similar, which, as late as the last century, had copper coins of such magnitude, that wheelbarrows were used to carry off a sum not very considerable.

MISCELLANEA.

Duration of Malleable Iron Rails.—Time was, when engineers generally were under the impression, that rolled iron-edge rails, of 50 lbs. to the yard, would last from forty to sixty years; but experience is fast dissipating all such notions, by demonstrating that the duration of rails of malleable iron is not determined by mere superficial wear, but by the time which it requires for a given amount of trade rolling upon them, to disintegrate them internally—that is, to produce disruption and exfoliation of the laminæ of which they are composed. Mr. Ellwood Morris, an American engineer, calculates that 1,500,000 tons gross weight, conveyed over rolled iron-edge rails of the T and H forms, weighing from 33lbs. to 42lbs. per yard, will destroy them in ten years. The rails of the Philadelphia and Columbia Railroad, which are of this description, have been in use only seven years, and are already exhibiting strong symptoms of coming destruction. Mr. Morris has the candour, at the same time, to mention that these results are in perfect accordance with what our countryman, Mr. W. Chapman, of Newcastle (see "Wood on Railroads"), predicted, many years ago, as most likely to happen.—*Railway Gazette.*

The Chemical Constitution of Plants.—The greater part of all vegetables consists of but four elements—namely, carbon, hydrogen, oxygen, and nitrogen; very often of the first three alone; while the remainder is composed of certain saline, earthy, and metallic compounds, which form the ashes that remain when vegeta-

bles are burned. The former are called the organic, the latter, the inorganic, elements of plants. Professor Liebeg has demonstrated that the latter, although occurring in a very small quantity, are yet as essential to the development of the plant as the former; and, it is obvious, that the first inquiry in such a work as his, must be as to the sources from which all these necessary constituents are derived, and the best means of supplying them. With regard to the carbon of plants, the general opinion of writers on vegetable physiology, and of practical agriculturists, attributes its origin to the substance called humus or vegetable mould, which is present in all fertile soils, and which is merely the remains of former vegetables in a state of decay. This substance, either alone or in combination with lime or other alkalies, is believed to be absorbed by the roots, and thus directly to furnish carbon for the plant. But this view has been shown by M. Liebeg to be quite untenable; and he has demonstrated, by a most ingenious and convincing train of argument, that the carbon of plants is derived from the carbonic acid of the atmosphere. In the economy of nature, the supply of carbon to plants is beautifully associated with the restoration to the atmosphere of the oxygen removed from it by the respiration of animals and other processes, and thus preserves the air constantly in the same state of fitness for the life of animals.

Machinery.—Cotton-spinning machinery, and manufacturing machinery in general, are merely varieties of the inventions of Androides, and toy-makers. A central power, with axles, wheels, cogs, ketches, ratches, straps, lines, levers, screws, &c., variously combined, to reverse, direct, take up, drop, increase and decrease motion, constitute the wonders of Lancashire, Yorkshire, Derbyshire, and Warwickshire.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, Aug. 3, S. Webbe, Esq., on the National Music of Wales, Ireland, and Scotland. Friday, Aug. 5, Major Beniowsky, on Phrenotypics. At half-past eight precisely.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Aug. 1, —— Bowkett, Esq., on the Usefulness of Poetry. At a quarter-past eight o'clock.

QUERIES.

The manner in which spirit of salts is prepared for soldering, and the best mode of cleaning brass prior to lacquering? J. Flinn.

What is the nature of the light produced by the rubbing of two stones against each other, and from what cause does the smell arise? It seems not to be electricity, the smell being different; nor to be similar to the sparks which are struck off iron or steel by a flint, or by another piece of iron or steel, which are red-hot pieces of the metal. L. G.

ANSWERS TO QUERIES.

"J. Watson." The size of every cog-wheel must, of course, be equal to the number of cogs required, and the relative proportions of the two wheels must be measured from the middle of the teeth, or each wheel must be supposed to be half the depth of a tooth larger than it really is.

"W. W." If by "sham or mock twist," is meant the brown shading, it is not sham or mock, but the barrels, being welded in strips, are afterwards twisted; so that the welds, which are always weaker than other parts, instead of being suffered to remain in a right line, and thereby being liable to burst, are forced into a spiral. The barrels are then covered with muriatic or nitric acid, &c., which acts on the welded parts differently to what it does on the pure iron, each shading, then, showing iron in a different state of purity. L. G.

To Stain Chairs.—Chairs are stained with orchil, applied warm with a brush, and, when dry, varnished. The yellow tinge is produced by muriatic acid.

To Clean Boot-tops.—The commonest application for cleaning boot-tops, is a solution of oxalic acid. Some use putty-powder; but if there be any preparation sold under the name of "bleaching composition," it, in all probability, is nothing more than the solution of chloride of lime.

To Remove Iron Moulds, &c.—Salt of lemons is the best thing for removing iron-moulds, &c. It is made by mixing, intimately, equal parts of salt of sorrel and cream of tartar. The corner of a napkin, moistened with water, and dipped into the above powder, to be well rubbed over the stain until it be erased.

"B. G." Grainers use boiled oil for common work, and spirit varnish for in-door work.

To Dissolve Tin.—Spirit of salt dissolves tin. This solution is sold by the druggists under the name of muriate of tin. Tacks dipped in this, I should think, would receive a coating of tin; at any rate they would, by the assistance of the electrotype process. E. H.

TO CORRESPONDENTS.

Answers to numerous correspondents in our next.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

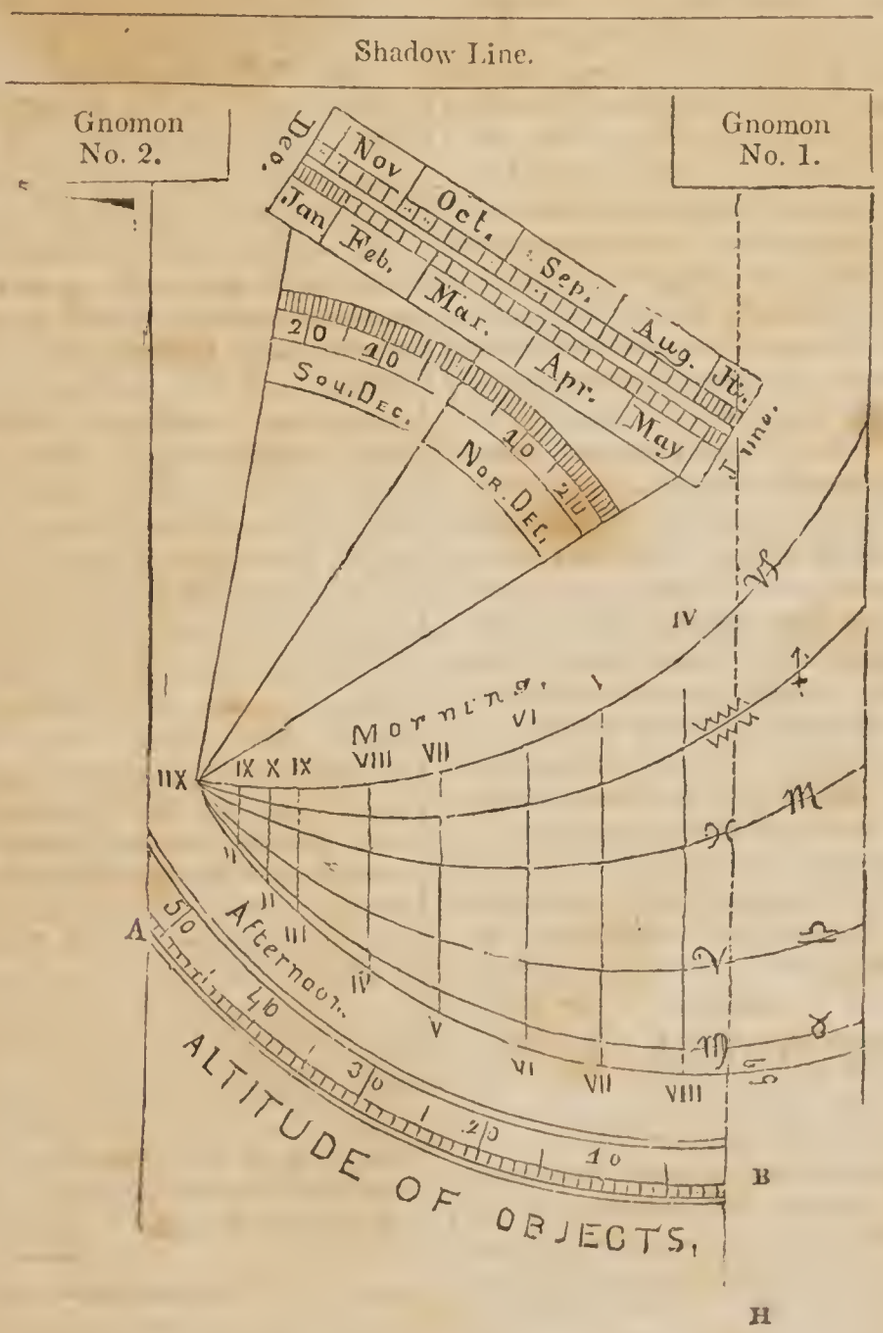
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 95, THIRD SERIES. | SATURDAY, AUG. 6, 1842. | No. 343, OLD SERIES.

PORTABLE CARD DIAL, TO FIND THE ALTITUDE OF OBJECTS.



Vol. VIII.—No. 36.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

CAUSES OF RAIN.

(Continued from page 277.)

In a work entitled "Thoughts on Meteorology," vol. 2, M. de Lac considers very particularly the grand phenomenon of rain, and the numerous circumstances connected with it. He examines the several hypotheses with considerable care, but thinks them, even if admissible, utterly insufficient to account for the formation of rain. The grand question in this inquiry is, what becomes of the water that rises in vapour into the atmosphere, or what state it subsists in there, between the time of the evaporation and its falling down again in rain? If it continue in the same watery vapour, or such as is the product of evaporation, it must possess the destructive character essential to that fluid. It must make the hygrometer move towards humidity, in proportion as the vapour is more or less abundant in the air. On a diminution of heat, the humidity, as shown by the hygrometer, must increase, and, on an increase of the heat, the humidity must diminish, and the introduction of other hydroscopic substances drier than the air, must have the same effect as an augmentation of heat. These are the properties of watery vapour on every hypothesis of evaporation; and, therefore, all the water that exists in the atmosphere, without possessing these properties, is no longer vapour, but must have changed its nature. M. de Lac shows that water which forms rain, though it has ever been considered and reasoned upon as producing humidity, does not possess these properties, and must, therefore, have passed into another state; as he thinks that the vapour passes into an invisible state, in the interval between evaporation and its falling again in rain, and that in that state it is not sensible to the hygrometer, as insufficient for explaining the formation of rain; but he does not pretend to have discovered the immediate cause of the formation of the clouds and rain. If it be in the immediate product of evaporation that rain has its source; if the vapour change its property in the atmosphere, so as no longer to be sensible to the hygrometer or to the eye; if they do not become vapour again, till clouds appear; and if, when the clouds have formed, no alteration be perceived in the quality of the air; we must acknowledge it to be very probable that the intermediate state of vapour is no other than air, and that the clouds do not proceed from any distinct fluid contained in the atmosphere, but from a decomposition of a part of the air itself, perfectly similar to the rest.

As to the use of rain, we may observe, that it moistens and softens the earth, and thus fits it for affording nourishment to plants. By falling on high mountains, it carries down with it many particles of loose earth, which serves to fertilize the surrounding valleys, and purifies the air from noxious exhalations, which tend, in their return to the earth, to ameliorate the soil; it moderates the heat of the air, and is one means of supplying fountains and rivers. However, vehement rains in many countries are found to be attended with barrenness and poorness of land, and miscarriage of the crop in the succeeding year; and the reason is plain—for these successive storms wash away the fine mould into the rivers, which carry it away into the sea, and it is a long time before the land recovers it again. The remedy for the famine to which some countries are subject from this sort of mischief, is the planting large orchards and groves of such trees as bear esculent fruit; for it is an observation that, in years when grain succeeds worst, those trees produce most fruit of all. It may partly be owing to the thorough moistening of all the earth, as deep as their roots go, by these rains, and partly to their trunks stopping some of the light mould carried down by the rains, and by these means furnishing themselves with a new coat of earth. We have numerous accounts in the historians of our own, as well as other countries, of preternatural rains—such as the raining of stones, of dust, of blood—nay, of living animals—as young frogs and the like. We are not to doubt the truth of what those, who are authors of veracity and credit, relate to us of this kind, so far as to suppose that the falling of stones and dust never happened: the whole mistake is the supposing them to have fallen from the clouds; but, as to the blood and frogs, it is very certain that they never fell at all; the belief of their descent arising from a mere deception of the eyes. Men are extremely fond of the marvellous in their relations; but the judicious reader is to examine strictly whatever is reported of this kind, and is not to suffer himself to be deceived.

Seeds of Plants.—The seeds of plants are their eggs. A sun-flower produces 4000; a poppy 30,000; a tobacco-plant 3 or 400,000; and spleen-wort 1,000,000. The capsule of the white poppy contains 8000 seeds. Some seeds germinate after boiling. The seeds of mosses germinate either in hot earth or in water

DESCRIPTION OF THE STONES USED IN LITHOGRAPHY,

AND THE MANNER IN WHICH THEY ARE PREPARED.

All calcareous stones imbibe grease and moisture, and effervesce with an acid, and are, therefore, capable of being used for lithography. Those are best adapted for the purpose, which are very compact, of a fine and equal grain, and free from veins or imbedded fossils or crystals.

The Griarius, of Solenhofen, near Pappenheim, in Bavaria, furnished the first plates, and none have, as yet, been found to equal them in quality. They are of a very uniform pale, yellowish-white colour. The fracture is perfectly rhomboidal. The beds divide into thin portions of considerable size, with perfectly flat surfaces, and were, on this account, carried to Munich and other places, for paving kitchens and halls; and thus came in the way of Senefelder, when he discovered the chemical process of printing. The stones of this quarry vary in their quality, but the best are in great abundance. Generally speaking, the hardest are the best, provided they are quite uniform in texture. Such are necessary for fine chalk drawings; softer ones may do for ink or for coarser drawings in chalk. In France, stones have been found near Chatenurouse (Department de l'Indu), of a similar colour to those of Solenhofen, and even harder and of a finer grain; but they are so full of large knots of a softer nature, that it is scarcely possible to get one perfect of a greater size than twelve inches square. In England, a stone has been used for lithography, which is found at Corston, near Bath. It is one of the white lias beds; but not so fine in grain, or so close in texture, as the German stone, and, therefore, far inferior. But it is good for transfers, and does tolerably well for ink drawings or routings. Another stone, found near Stony Stratford, is also used; but it is of a brownish-grey tint, and too dark in colour to show the effect of the drawing with sufficient clearness. To bear the pressure used in taking the impressions, a stone, twelve inches square, should be at least one inch and a quarter thick. The thickness must increase with the size of the stone; but two inches and a half are a thickness sufficient for stones of three feet by three feet and a half. The stones, when sawn to a proper size and thickness, are ground level, by rubbing two of them face to face with water and sand, and very carefully examined with a straight edge, to ascertain that they are perfectly level in all directions. This applies only to the side which is afterwards to receive the drawing, as the natural division of the stone is sufficiently true for the back. To prepare them for chalk drawings, two stones, which have been perfectly levelled, are well washed, in order to free them from any of the coarser grains of sand which have been previously used upon them. They are now to be placed on a board over a trough, and a small quantity of water and very fine sand being strewed over the surfaces, they are to be rubbed face to face, adding, occasionally, a little fresh sand and water. The best sort of sand in England, is that called silver sand, for preparing the stone, and the common brown sand for giving a fine grain. The sand must be passed through a sieve of the fineness required, which will vary with the nature of the drawing; and the greatest care must be taken to have the sieves perfect, and to prevent any coarser particles of sand from being mixed with the rest. A single grain would fill the stone with innumerable scratches, which would all appear in the drawing. The upper stone is, in this operation, moved in small circles, carefully and equally all over the under one; taking care not to move the one beyond the edge of the other, or the faces would become rounded. When the grain is equal and sufficiently fine, the stones are carefully washed and wiped with a clean cloth. The stone, thus prepared, should have, when dry, a perfectly uniform appearance in the colour and grain, and resemble a sheet of vellum. It should be free from scratches, and have no shining parts. The upper is always the finer grained of the two. Sometimes dry sand alone is used; but it is better to use it with water. To prepare the stones for ink drawings or writings, the process just described is first followed; they are then well washed, to get rid of the sand, and the same operation of rubbing two together, is continued with powdered pumice-stone and water. When perfectly smooth, they are again washed, and afterwards separately polished with a large piece of fine pumice-stone, with a circular motion. The polish now given to the stone, should be such as to show the reflection of objects to the eye placed close to the stone, and looking along it towards the light.

When a writing or drawing has been fully used, and the stone is to be again prepared, sand is strewed over the surface, and it is sprinkled with water, and rubbed with another stone, as before described, till the drawing has disappeared. It must

then be washed with aquafortis, diluted with twenty times its bulk of water. This is absolutely necessary to destroy the lines, which would otherwise partially reappear in printing a second drawing from the same stone. After this, the stone is again prepared for a new drawing with fine sand, in the manner before described. Ink drawings sink deeper into the stone than the chalk, and require the stone to be more ground away to efface them. The longer drawings remain on the stone, the deeper the ink or the chalk penetrates.

HISTORY OF MEDALS.

(Continued from page 279.)

Some coins are found which exceed the as libralis in weight; and these are supposed to be prior to the time of Servius Tullius. Some of them are met with of thirty-four and fifty-three Roman ounces; having, upon one side, the figure of a bull rudely impressed, and upon the other the bones of a fish. They are mostly found at Tudder, or Tudertum, in Umbria; but they appear always broken at one end; so that Mr. Pinkerton is of opinion, that perhaps some might be struck of the decussis form, or weighing ten pounds. These pieces, in our author's opinion, make it evident, that the Romans derived their large brass coins from the Etruscans and the neighbouring states. They are all cast in moulds; and the greater part of them appear much more ancient than the Roman ases, even such as are of the greatest antiquity.

Mr. Pinkerton agrees with Sir Isaac Newton, as to the time that Servius Tullius reigned in Rome, which he supposes to be about 460 B. C. His coinage seems to have been confined to the *as*, or piece of brass, having the impression of Janus on the one side, and the prow of a ship on the other; because Janus arrived in Italy by sea. Varro, however, informs us, that the very first coins of Tullius had the figure of a bull or other cattle upon them, like the Etruscan coins, of which they were imitations. Those with the figure of Janus and the prow of a ship upon them, may be supposed first to have appeared about 400 B. C.; but, in a short time, various subdivisions of the *as* were coined. The semis or half, is commonly stamped with the head of Jupiter, laureated; the triens or third, having four cyphers, as being originally of four ounces weight, has the head of Minerva; the quadrans or quarter, marked with three cyphers, has the head of Hercules wrapt in the lion's skin; the sextans or sixth, having only two cyphers, is marked with the head of Mercury with a cap and wings; while the uncia, having only one cypher, is marked with the head of Rome. All these coins appear to have been cast in moulds, by a considerable number at a time; and in the British Museum there are four of them, all united together, as taken out of the mould, in which, perhaps, dozens were cast together. In process of time, however, the smaller divisions were struck, instead of being cast; but the larger still continued to be cast until the *as* fell to two ounces. Even after this time, it was still called libra, and accounted a pound of copper; though there were now larger denominations of it coined, such as the *bissas* or double *as*; tressis and quadrussis, of three and four ases—nay, as far as decussis or ten ases, marked X. Olivieri mentions one in his own cabinet, weighing upwards of twenty-five ounces, and cast when the *as* was about three ounces weight. There is, likewise, in the Musæum Etruscum, a decussis of forty Roman ounces, cast when the *as* was at four ounces. There was, likewise, a curious decussis in the Jesuits' library at Rome, for which an English medallist offered 20*l.*; but it was seized by the Pope, along with every other thing belonging to the Society.

Mr. Pinkerton contests the opinion of Pliny, that the *as* continued of a pound weight till the end of the first Punic war. His opinion, he says, is confuted by the coins which still remain; and it appears probable to him, that the *as* decreased gradually in weight; and from one or two of the pieces which still exist, he seems to think that the decrease was slow, as from a pound to eleven ounces, then to ten, nine, &c.; but neither the *as* nor its parts were ever correctly sized. During the time of the second Punic war, when the Romans were sore pressed by Hannibal, the *as* was reduced to a single ounce. It is said to have taken place in the 215th year before our era, being about thirty-six years after the former change. This as libralis, with the faces of Janus upon it, is the form most commonly met with previously to its being reduced to two ounces. Our author supposes, that the as libralis continued for at least a century and a half after this coinage of Tullius, down to 300 B. C., about the year of Rome 452, between which and the 502nd year of Rome, a gradual diminution of the *as* to two ounces, must have taken place. The following table of the dates of the Roman coinage, is given by Mr. Pinkerton.

The libralis, coined by Tullius, with the figures of oxen, &c., about 167 years after the building of Rome, according to Sir Isaac Newton, or about the year before Christ 460
As libralis, with Janus and the prow of a ship 400
As of ten ounces 300
Eight 290
Six 280
Four 270
Three 260
Two, according to Pliny 250
One, according to the same author .. 214

About 175 B. C. also, we are informed by Pliny, that the *as* was reduced to half-an-ounce by the Papyrian law, at which it continued till the time of Pliny himself, and long after.

After the Romans began to have an intercourse with Greece, a variety of elegant figures appear upon the parts of the *as*, though not on the *as* itself, till after the time of Sylla. Towards the latter end of the republic also, dupondii or double ases, were coined, together with the sestertii ærei, which came in place of the quadrusses, when the denarius began to be reckoned at sixteen ases; probably at the time the latter was reduced to half-an-ounce. In some instances, it is to be observed, that the Romans accommodated their coins to the country where their army was stationed; whence we have many coins marked as Roman, which have been coined in Magna Græcia and Sicily, and are evidently upon the Greek and not the Roman scale. In the latter part of the republican times, also, the types begin to vary; so that we have a brass coin supposed to be struck by Sextus Pompeius, in Sicily, having upon it a double head of that warrior, representing a Janus. Mr. Pinkerton supposes it to have been a dupondius; which, indeed, appears to be the case, from the double head. This coin is of copper, and still weighs an ounce, notwithstanding its antiquity.

The largest imperial copper coin, was the sestertius, a piece worth about twopence of our money. Mr. Pinkerton censures severely the opinion of other medallists, all of whom say that the sestertius was of silver. "In fact," says he, "it would be as rational in any antiquary, a thousand years hence, to contend that the halfpenny and farthing are of silver, because they were so in the reign of Henry VIII." In confirmation of his own opinion, he quotes the following passage from Pliny:—"The greatest glory of brass is now due to the Marian, called also that of Cordova. This, after the Livian, most absorbs the lapis calaminaris, and imitates the goodness of native orichalcum in our sestertii and dupondiarii, the ases being contented with their own copper." Gronovius confesses that he does not know what to make of this passage, and that it causes him to hesitate in his opinion. The Livian mine mentioned here by Pliny, is supposed to have got its name from Livia, the wife of Augustus; and it is probable that the pieces marked with her portraits, entitled *Justitia*, *Salus*, *Virtus*, &c., were dupondii from this very mine, the metal being exceedingly fine, and of the kind named Corinthian brass by the ancient medallists. "Perhaps," says Mr. Pinkerton, "the mine received its name from this very circumstance of her coins being struck in the metal taken from it."

TO FIND THE ALTITUDE OF OBJECTS.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

SIR,—If you think the following worthy a place in your valuable Magazine, it is at your service.

To the "Portable Card-dial," so accurately described in Nos. 88 and 89, may be added a very simple, but useful and interesting appendage, for ascertaining the height of trees, buildings, &c., in the following manner:—

After having constructed a dial, the same as the engraving, draw an arc of altitudes as follows:—From the sun's place on the line of months, for the 21st of June, as a centre, sweep the arc, A B, which must be graduated either by a sector or other instrument; numbering from the dotted line, C D, which must be drawn at right angles to the shadow-line, cutting the centre upon which the arc of altitudes is struck. Then make another gnomon, No. 2, same as No. 1, but on the opposite side of the card, and you have the addition required.

To ascertain the height of any building, tree, &c., stand 20, 30, or 40 feet or more from the object; move the thread of the dial to the longest day (June 21), letting it play freely; then look along the top of the gnomon, bringing the object in a line with the shadow-line, and observe which degree of the arc of altitude is cut by the thread; and, by looking in the annexed table against that degree, and under the distance from the object, you will have the height above the eye.

Degree of Altitude.	Feet distant from the Object.						
	20	30	40	50	60	70	80
10	3.52	5.29	7 05	8.81	10.58	12.34	14.10
11	3.98	5.83	7.77	9.72	11.66	13.60	15.55
12	4.25	6.37	8.59	10.63	12.75	14.88	17.00
13	4.61	6.92	9.23	11.54	13.85	16.16	18.47
14	4.98	7.48	9.97	12.46	14.96	17.45	19.94
15	5.36	8.04	10.72	13.39	16.07	18.75	21.43
16	5.73	8.60	11.47	14 33	17.20	20.07	22.94
17	6.11	9.17	12.23	15.28	18.34	21.40	24.46
18	6.50	9.75	12.92	16.24	19.49	22.74	25.99
19	6.88	10.33	13.77	17.21	20.66	24.10	27.54
20	7.38	10.92	14.56	18 20	21.84	25.48	29.11
21	7.67	11.51	15.35	19.19	23.03	26.87	30.71
22	8.08	12.12	16.16	20.20	21.24	28.28	32.32
23	8.49	12.73	16.98	21.22	25.47	29.71	33 96
24	8.90	13.35	17.81	22.26	26.71	31.16	35.62
25	9.32	13.99	18.65	23.31	27.98	32.64	37.30
26	9.75	14.63	19.51	24.38	29.26	34.14	39.02
27	10.19	15.28	20.38	25.47	30.57	35.66	40.76
28	10.63	15.95	21.27	26.58	31.90	37.22	42.35
29	11.08	16.63	22.17	27.71	33.26	38.80	44.34
30	11.54	17.32	23.09	28.86	34.64	40.11	46.19
31	12.01	18.02	24.03	30.04	36.05	42.06	48.07
32	12.49	18.74	24.99	31.24	37.49	43.74	49.99
33	12.99	19.48	25.96	32.47	38.96	45.46	51.91
34	13.49	20.23	26.98	33.72	40.17	47.21	53.96
35	14.00	21.00	28.01	35.01	42 01	49.01	56.01
36	14.53	21.79	29.06	36.32	43.59	50.86	58.12
37	15.07	22.60	30.14	37.68	45.21	52.75	60.28
38	15.62	23.44	31.25	39.06	46.87	54.69	62.50
39	16.19	24.29	32.39	40.49	48.58	56.68	64.78
40	16.78	25.17	33.56	41.95	50.34	58.73	67.13
41	17.38	26.08	34.77	43.46	52.15	60.85	69.54
42	18.01	27.01	36.01	45.02	54.02	63.03	72.03
43	18.65	27.97	37.03	46 62	55.95	65.27	74.60
44	19.31	28.97	38.62	48.28	57.91	67.60	75.25
45	20.00	30.00	40.00	50.00	60.00	70.00	80.00
46	20.71	31.06	41.42	51.77	62.13	72.48	82.84
47	21.44	32.17	42.89	53.62	61.34	75.06	85.79
48	22.21	33.32	44.42	55.55	66.63	77.74	88 85
49	23.00	34.51	46.01	57.52	69.02	80.52	92.03
50	23.83	35.75	47.67	59.59	71.50	83.42	95.34
51	24.70	37.04	49.39	61.74	74.09	86.44	98.79
52	25.60	38.40	51.19	63.99	76.79	89.59	102.39
53	26.54	39.81	53.08	66.35	79.62	92.89	106.16
54	27.52	41.29	55.05	68.82	82.58	96.34	110.11

Thus, if at the distance of forty feet from a tower, you look along the bounding or shadow-line, or the top of the gnomons, and the thread cuts the arc of altitudes at 42°; then, by referring to the table against 42°, under 40, at the top, is 36.01 for the height above the eye; and, supposing the eye to be five feet from the ground, the height of the tower will be forty-one feet and a small fraction of a foot. Or the height may be ascertained without the table, by working the problem—viz. having the length of the base, and the angle of the hypothenuse of a right-angled triangle given, what is the height of the perpendicular.

I remain yours, &c.,

R. S. W.

ELECTRICAL EXPERIMENTS.

(Continued from page 278.)

Exp. 5. If a small sewing-needle be accurately suspended from a small piece of cork in a basin of water, one end of it will point to the north, and the other to the south; at the same time discharging the battery through it, the needle becomes magnetic.

6. Place a piece of very dry wood between the balls of the universal discharger, so that the fibres of the wood may be in the direction of the wires, and pass the charge of the battery through them, the wood will be torn in pieces. The points of the wires being run into the wood, and the shock passed through them, will effect the same thing.

7. Take a glass tube, open at both ends, six inches long, and a quarter of an inch in diameter; take two pieces of cork, with wires in them, exactly to fit the ends of the tube: put in one cork, and fill the tube with water; then put the other cork in, and push them so that they nearly touch, and pass the charge of the battery through them; the tube will be broken, and the water dispersed in every direction. To prevent accidents, a wire cage should be put over the tube before the discharge is made. Young persons should not attempt this experiment by themselves.

8. The electric fluid, like common fire, converts the water into a highly elastic vapour, which, occupying very suddenly a much larger space than the water, bursts the tube before it can effect any means of escape. When a succession of electrical discharges from a powerful electrical machine are sent through water, a decomposition of that fluid takes place; and it is resolved into its two elements of oxygen and hydrogen, which immediately assume the gaseous form.

9. If a ball of box-wood be placed on the conductor, instead of the brass ball, a spark taken from it will be of a fine red colour.

10. An ivory ball placed on the conductor, will be rendered very beautiful and luminous, if a strong spark be taken through its centre.

11. Sparks taken over a piece of silver leather, appear of a green colour; and over gilt leather, of a red colour.

12. Take a glass tube, round which, at small distances from each other, pieces of tinfoil are pasted, in a spiral form; from end to end, this tube is enclosed in a larger one, fitted with brass caps at each end, which are connected with the tinfoil of the inner tube. I hold one end in my hand, and, while another turns the machine, I present the other end to the conductor, to take sparks from it: but first darken the room. It is a very beautiful experiment; the beauty of it consists in the distance which is left between the pieces of tinfoil, and, by increasing the number of the distances, the brilliancy is very much heightened.

13. The following is another experiment of the same kind:—Make a word, with which you are acquainted, on glass, by means of tinfoil pasted on glass, fixed in a frame of baked wood, having a ball fastened at each end of the glass. I hold the frame in my hand by one end, and present the other ball to the conductor, and, at every considerable spark, the word is beautifully illuminated.

14. A piece of sponge filled with water, and hung to the conductor when electrified in a dark room, exhibits a beautiful appearance.

15. Place a drop of water on the conductor, and work the machine; the drop will afford a long spark, assume a conical figure, and carry some of the water with it.

16. Fix a wire to a piece of sealing-wax, and, having fixed the wire into the end of the conductor, light the wax, and, the moment the machine is worked, the wax will fly off in very fine filaments.

17. I wrap some cotton wool round one of the knobs of my discharging rod, and fill the wool with finely-bruised resin, and discharge a Leyden jar or battery in the common way, and the wool is instantly in a blaze. The covered knob must touch the knob of the jar, and the discharge should be effected as quickly as possible.

18. Take a two-ounce phial half full of salad oil; through the cork is passed a piece of slender wire, the end of which, within the phial, is so bent as to touch the glass just below the surface of the oil. I place my thumb opposite the point of wire in the bottle, and, in that position, take a spark from the charged conductor; you will observe the spark to get to my thumb, and perforate the glass. In the same way holes may be made round the phial.

19. Fix a pointed wire upon the prime conductor, with the point outward, and another similar wire upon the insulated rubber; darken the room, and work the machine. Now observe the points of the two wires, they will both be illuminated, but differently. The point on the conductor sends out a sort of brush of fire, but that on the rubber is illuminated like a star. The appearance of a star on the point of

the wire, shows that the electricity is positive; but if it be that of a luminous brush, it indicates the electricity to be negative.

20. Take two wires, one of which is connected with the outside of a charged Leyden jar, the other so bent as easily to touch the knob of the jar; the two straight ends I bring within the distance of the tenth of an inch of each other, and press them down with my thumb, and, in this position, having darkened the room, I discharge the jar. Look at your thumb, it will appear so transparent, that you think you can see the bone; and with attention you might observe the principal blood-vessels. The only inconvenience that is felt, is a sort of tremor in the thumb, which is by no means painful. Had the wires been at double the distance, the shock would have probably made the thumb the circuit, which must have caused a more powerful sensation; but, being so close, the electric fluid leaped from one wire to the other, and, during this passage, illuminated the thumb, but did not go through it. If, instead of the thumb, a decanter full of water, having a flat bottom, be placed on the wires, and the discharge made, the whole of the water will be beautifully illuminated.

W. Hopkinson.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, Aug. 26, Nomination of Candidates for the Committee. At half-past eight precisely.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Aug. 8, Mr. Fenner, on the Comparative Merits of Co-operation, Emigration, &c. At a quarter-past eight o'clock.

QUERIES.

How can I make, or where can I obtain, machines for embossing cards, together with a description and price of them? Also, will any one oblige me with a description of a machine for cloud and water engraving, the probable cost, and where to procure one? Utile.

Being in the habit of blueing small portions of iron and steel, which I do by means of a hot bar, and by which means I cannot get a good blue, I shall feel obliged if any of your readers can inform me of a better method. Also, what will keep them from getting rusty, as oil of itself changes the colour? I have no objection to pay a trifle for the information, if the person will forward his address in a letter (post paid), directed to J. Reid, 31, Warren Street, Tottenham Court Road.

Is there any blue vegetable colouring matter, either natural or artificial, with the exception of indigo, which, when in solution, is unacted upon by free sulphuric acid? Quis.

The best method of making tracing paper, and applying the same. A. W. M.

1. Will any of your numerous correspondents be so kind as to inform me of an easy method to test silver, similar to a trial of gold rubbed on stone, and tested with aquafortis? I am aware there is a test in No. 91, but that cannot be used in all ordinary cases, without destroying the article or part. 2. If a weight of nine pounds be used as a propelling power to a train of four wheels, and one wheel be added, how much more weight must be employed to give the same force to the five wheels; and, again, six and seven wheels, how much more weight is required to be added each time, to give the same force to each train? I believe the number of teeth in each wheel does not affect the first given power; but I believe, as a general rule, the larger the wheels, the greater force is obtained over the same propelling power, than by using small wheels. 3. Where can I obtain cyanide of potassium, and how to prepare the oxide of silver or gold? or where can I obtain it for electrotype purposes?

J. W.

Having received a letter from a friend in the country, requesting me to inquire respecting a small steam-boiler, that a person of the name of "Highs" had to dispose of, as mentioned in No. 78, Third Series, should "Mr. H." not have disposed of it, I should feel obliged if he would favour me with his address.

N. Evans.

23, Red Lion Street, Clerkenwell.

What is the best wax for modelling, such as likenesses in miniature, and where is the best place to obtain it? Also, the best method of smoothing the wax after the likeness is formed?

W. G.

TO CORRESPONDENTS.

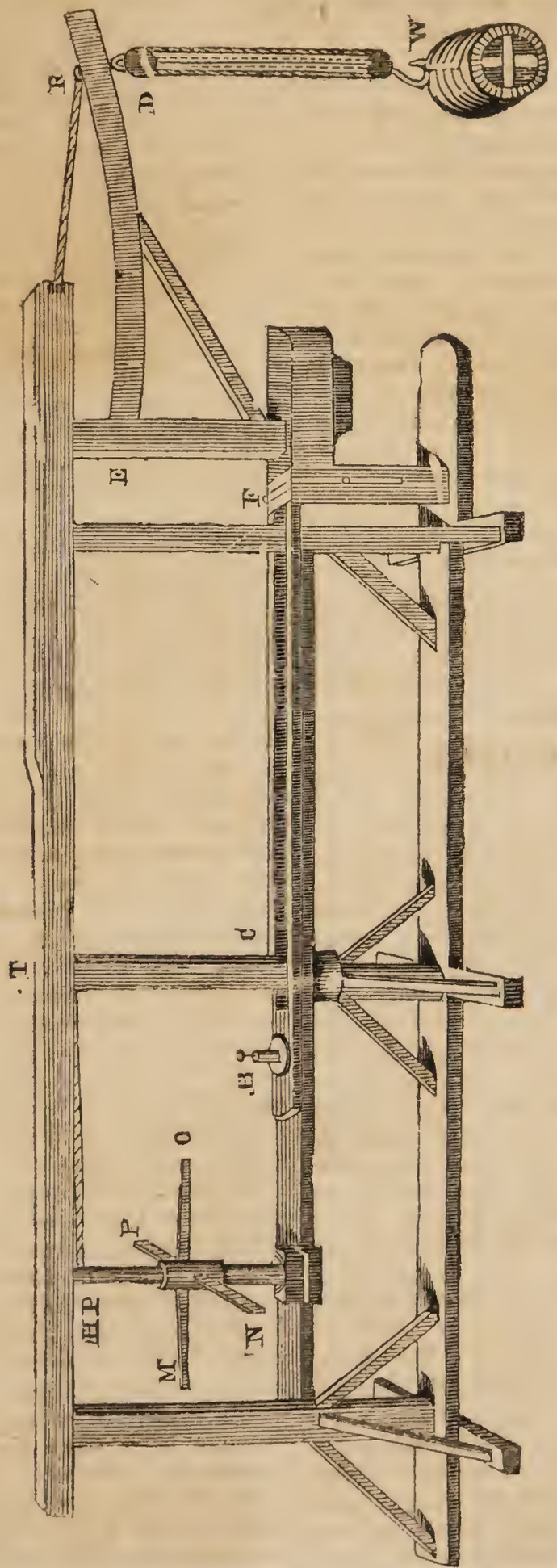
Inventicus *can have his invention registered, by making application at the Patent Office. He would receive no real benefit by making it known to the Society of Arts in the Adelphi. The subject is one to which we have ourselves given some attention. It is certain that there is room for great improvement, and that perfection in the art has yet to be attained; and we shall be glad to find that the system of "Inventicus" is really a good one. If our correspondent be not afraid to trust us with a description, we shall be happy to give him our opinion, and especially as to whether it would be really worth his while to have it patented.*

Amateur Mechanic, Marylebone, *in our next.*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC
AND CHEMIST.

No. 96, THIRD SERIES. | SATURDAY, AUG. 13, 1842. | No. 344, OLD SERIES.



ANDREWS' WEIGHING CRANE.

Vol. VIII.—No. 37.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ANDREWS' WEIGHING CRANE.

(See Engraving, front page.)

In answer to our correspondent, "T. Jenkins," we believe a weighing machine, similar to what he speaks of, was invented by a Mr. Andrews; a description of which we give, copied from a volume of the "Encyclopædia Britannica."

Description of the Engravings.

The weight, W, is elevated by means of the levers, M N O P, which coil the rope, H R, round the barrel, H. The jib, E D, stands on a horizontal beam, moveable in a vertical plane round the centre, F A; and the distance of the upright beam, E, from the centre of motion, A, is one-twentieth of B F. The weight of the body, W, is then ascertained by the weight at H, which keeps it in equilibrio. The piece of wood, C, projects from the vertical beam, C T, in order to prevent the beam from rising too high.

CAUSES OF RAIN.

(Continued from page 282.)

There are two natural methods by which quantities of stones and dust may fall in certain places, without their having been generated in the clouds, or fallen as rain. The one is by means of hurricanes; the winds, which we frequently see tearing off the tiles of houses, and carrying them to considerable distances, being equally able to take up a quantity of stones, and drop them again at some other place. But the other, which is much the most powerful, and, probably, the most usual way, is for the eruptions of volcanoes and burning mountains to toss up (as they frequently do) a vast quantity of stones, ashes, and cinders, to an immense height in the air; and these being hurried away by the hurricanes and impetuous winds which usually accompany those eruptions, and being in themselves much lighter than common stones, as being half calcined, may easily be thus carried to vast distances; and then, falling in places where the inhabitants know nothing of the occasion, they cannot but be supposed by the vulgar to fall on them from the clouds.

It is well known that, in the great eruptions of Etna and Vesuvius, showers of ashes, dust, and small cinders, have been seen to obscure the air and overspread the surface of the sea for a great way, and cover the decks of ships; and this at such a distance, as it should appear scarcely conceivable that they would have been carried to; and, probably, if the accounts of all the showers of those substances mentioned by authors be collected, they will all be found to have fallen within such distances of volcanoes; and, if compared as to the time of their falling, will be found to correspond in that also with the eruptions of those mountains. We have known instances of the ashes from Vesuvius having been carried thirty, nay, forty leagues; and peculiar accidents may have carried them yet farther. It is not to be supposed, that these showers of stones and dust fall for a continuance, in the manner of showers of rain, or that the fragments of pieces are as frequent as drops of water; it is sufficient that a number of stones, or a quantity of dust, fall at once on a place, when the inhabitants can have no knowledge of the part from whence they came, and the vulgar will not doubt their dropping from the clouds. Nay, in the canton of Berne, in Switzerland, the inhabitants accounted it a miracle, that it rained earth and sulphur upon them at a time that a small volcano terrified them: and even while the wind was so boisterous, and hurricanes so frequent, that they saw, almost every moment, the dust, sand, and little stones, torn up from the surface of the earth in whirlwinds, and carried to a considerable height in the air; they never considered, that both the sulphur thrown up by the volcano, and the dust carried from their feet, must fall somewhere soon after. It is very certain that, in some of the terrible storms of large hail, where the hailstones have been of many inches round, on breaking them, there have been found what people call *stones in their middle*: but these observers needed only to have waited the dissolving of one of these hailstones, to have seen the stone in its centre diminish also; it being only formed of the particles of loose earthy matter which the water, exhaled by the sun's heat, had taken up in extremely small *moleculæ* with it; and this only having served to give an opaque hue to the inner part of the congelation, to which the freezing of the water alone gave the apparent hardness of stone.

The raining of *blood* has ever been accounted a more terrible sight, and more fatal omen, than the other preternatural rains already mentioned. It is very certain, that Nature forms blood nowhere but in the vessels of animals, and, therefore, showers of it from the clouds are by no means to be credited. Those who suppose, that what has been taken for blood, has been actually seen falling through the air, have had recourse to flying insects for its

origin, and suppose it the eggs or dung of certain butterflies, discharged from them as they were high up in the air. But it seems a very wild conjecture; as we know of no butterfly whose excrement or eggs are of such a colour, or whose abode is so high, or their flocks so numerous, as to be the occasion of this. It is most probable, that these bloody waters were never seen falling; but that people, seeing the standing waters blood-coloured, were assured, from their not knowing how else it might happen, that it had rained blood into them. A very memorable instance of this took place at the Hague, in the year 1670. One morning the whole town was in an uproar, on finding their ditches and lakes full of blood, as they thought; and having been certainly full of water the night before, they agreed that it must have rained blood in the night. But a certain physician went down to one of the canals, and, taking home a quantity of this blood-coloured water, he examined it by the microscope, and found that the water was water still, and had not at all changed its colour, but that it was full of prodigious swarms of small red animals, all alive, and very nimble in their motions, whose colour and immense number gave a red tinge to the whole body of the water they lived in, on a less accurate inspection. The certainty that this was the case, did not, however, persuade the Hollanders to part with the miracle; they prudently considered, that the sudden appearance of such a number of animals, was as great a prodigy as the raining of blood would have been; and are assured to this day, that this portent foretold the scene of war and destruction which Louis XII. afterwards brought into that country, which had before enjoyed forty years of uninterrupted peace.

The animals which thus colour the water of lakes and ponds, are *pulices arborescentes* of Swammerdam, or the water-flea, with branched horns. These creatures are of a reddish-yellow or flame colour; they live about the sides of ditches, under weeds, and among the mud, and are, therefore, the less visible, except at a certain time, which is in the beginning or end of June. It is at this time that these little animals leave their recesses to float loose about the water, to meet for the propagation of their species, and, by that means, become visible, by the colour they give the water. This is visible, more or less, in one part or other of almost all standing waters at this season; and it is always at this season that the bloody waters have alarmed the ignorant.

(To be continued.)

PROPERTIES OF ATMOSPHERIC AIR.

Air is an elastic fluid, invisible, indeed, but easily recognised by its properties Its specific gravity, when the barometer is at thirty inches, and the thermometer between 50° and 60°, is 0.0012, or 816 times lighter than water. One hundred cubic inches of air weigh thirty-one grains troy. But as air is an elastic fluid, and compressed at the surface of the earth by the whole weight of the incumbent atmosphere, its density diminishes according to its height above the surface of the earth. From experiments which have been made, it has been ascertained, that the density diminishes in the ratio of the compression. Consequently, the density decreases in a geometrical progression, while the heights increase in an arithmetical progression. Bouguer had suspected, from his observations made on the Andes, that, at considerable heights, the density of the air is no longer proportional to the compressing force; but the experiments of Saussure, junior, made upon Mount Rose, have demonstrated the contrary.

Although the sky is well known to have a blue colour, yet it cannot be doubted that air itself is altogether colourless and invisible. The blue colour of the sky is occasioned by the vapours which are always mixed with the air, and which have the property of reflecting the blue rays more copiously than any other. This has been proved by the experiments which Saussure made with his cyanometer at different heights above the surface of the earth. This consisted of a circular band of paper, divided into fifty-one parts, each of which was painted with a different shade of blue; beginning with the deepest, mixed with black, to the lightest, mixed with white. He found that the colour of the sky always corresponds with a deeper shade of blue, the higher the observer is placed above the surface; consequently, at a certain height, the blue will disappear altogether, and the sky appear black—that is to say, will reflect no light at all. The colour becomes always lighter in proportion to the vapours mixed with the air; hence it is evidently owing to them.

Air is a compound of oxygen and nitrogen; but it becomes a question of considerable consequence, to determine the proportion of these two ingredients, and to ascertain whether that proportion is in every case the same. Since nitrogen gas, one of the component parts of that fluid, cannot be separated by any substance with which chemists are acquainted, the

analysis of air can only be attempted by exposing it to the action of those bodies which have the property of absorbing its oxygen. By these bodies the oxygen gas is separated, and nitrogen gas is left behind, and the proportion of oxygen may be ascertained by the diminution of bulk; which once known, it is easy to ascertain the proportion of nitrogen gas, and thus to determine the exact relative quantity of the component parts.

After the composition of the atmosphere was known to philosophers, it was taken for granted, that the proportion of its oxygen varies in different times and in different places; and that upon this variation the purity or noxious qualities of air depended. Hence it became an object of the greatest importance, to be in possession of a method of determining readily the quantity of oxygen in a given portion of air. Accordingly, various methods were proposed, all of them depending upon the property which a variety of bodies possess of absorbing the oxygen of the air, without acting upon its azote. These bodies were mixed with a certain known quantity of atmospheric air, in graduated glass vessels inverted over water, and the proportion of oxygen was determined by the diminution of bulk. These instruments received the name of eudiometers, because they were considered as measures of the purity of air.

It is considered as established by experiment, that air is composed of 0.22 of oxygen gas, and 0.78 of nitrogen gas by bulk. But as the weight of these two gases is not exactly the same, the proportion of the component parts by weight will differ a little; for, as the specific gravity of oxygen gas is to that of nitrogen gas, as 135 : 115, it follows that 100 parts of air are composed by weight of about

74 nitrogen gas,
26 oxygen gas.

100

Having thus ascertained the nature and the proportion of the component parts of air, it remains only to inquire in what manner these component parts are united. Are they merely mixed together mechanically, or are they combined chemically? Is air a mechanical mixture or a chemical compound? Philosophers seem at first to have adopted the former of these opinions, if we except Scheele, who always considered air as a chemical compound. But the supposition that air is a mechanical mixture, by no means agrees with the phenomena which it exhibits. If the two gases were only mixed together, as their specific gravity is different, it is scarcely possible that they would be uniformly mixed in every part of the atmosphere. Even Mr. Dalton's ingenious supposition, that they neither attract nor repel each other, would not account for this equal distribution; for, undoubtedly, on that supposition, they would arrange themselves according to their specific gravity. Since, therefore, air is in all places composed of the same ingredients, exactly in the same proportions, it follows that its component parts are not only mixed, but actually combined. When substances, differing in specific gravity, combine together, the specific gravity of the compound is usually greater than the mean. This holds, also, with respect to air. The specific gravity, by calculation, amounts only to 0.00119, whereas it actually is 0.0012; a difference by no means inconsiderable. But, perhaps, the specific gravity of nitrogen and oxygen gas, can scarcely be considered as known with such precision, as to entitle us to draw any consequence from this difference.

The air is to be considered as a chemical compound. Hence the reason that it is in all cases the same, notwithstanding the numerous decomposing processes to which it is subjected. The breathing of animals, combustion, and a thousand other operations, are constantly abstracting its oxygen, and decomposing it. The air, thus decomposed or vitiated, no doubt ascends in the atmosphere, and is again, by some unknown process or other, reconverted into atmospherical air. But the nature of these changes is at present concealed under an impenetrable veil.

(To be continued.)

LITHOGRAPHIC PRINTING.

(*Continued from page* 284.)

When the stone is to be printed from, it is placed on the bed or platten of the press; at this time, a proper-sized scraper for the printing, is very carefully adjusted to the surface of the stone. The form on the stone is now sprinkled with rain-water, and, being gradually dissolved, and a wet sponge passed lightly all over it, the printer works the ink, which is on the colour-table placed beside him, with the roller in all directions, till it is equally and thinly spread all over the roller. He then (the stone being wet) passes the roller all over the stone, in both directions; observing (as his experience enables him to do) that all parts of the drawing take the ink in due proportion. The

roller should be applied with an equal motion and pressure, which must be regulated according to the mode in which the drawing takes the ink; if it does not take it readily, the pressure must be increased, and the roller moved more slowly. The roller should turn freely as it passes over the stone; if it slips, the cause is either that the stone is too wet, or that too much of the gum remains upon the stone. In the first case, a drier sponge will correct the evil; in the second, the stone must be again washed with a little water; but this must be done with caution, as the gum should not be entirely washed off the stone. At first, the drawing receives the ink with some difficulty; and it is frequently necessary to wet the stone, and roll it in several times, before it will take the ink readily. Care must now be taken not to wet the stone too much. The less dampness the better, provided it is sufficient to keep the stone from taking the ink in the parts where there is no drawing; at all events, no drops of water should be seen on the stone, as they spoil the printing-ink, and also are imbibed by the roller, which, therefore, becomes unfit for use. After the drawing is thus rolled in, the sheet of paper is placed on the stone, and the impression taken in the manner described in the account of the press; when, after the impression, the paper is taken up, the stone appears dry, the moisture having been imbibed by the paper. It must again be wetted with a damp sponge, and rolled in with ink as before; taking care to work the roller well on the colour-table each time, before applying it to the stone. Generally, the first few impressions are imperfect, from the drawing not taking the ink fully; but this is gradually corrected.

During the printing, some gum must always remain on the stone, though it will not be visible; otherwise the ink will take on the stone, and also spoil the drawing. If by too much wetting, or by rubbing too hard with the sponge, the gum be entirely removed, some fresh gum-water must be laid on. If the stone has, in the first instance, been laid by with too small a quantity of gum, and the ink stain the stone on being first applied to it, gum-water must be used to damp the stone, instead of pure water. Sometimes, however, this may arise from the printing-ink being too thin, as will appear below. If some spots on the stone take the printing-ink, notwithstanding the above precautions, some strong acid must be applied to them with a brush; and, after this is washed off, a little gum-water is dropped on the place. A steel point is here frequently necessary to take off the spots of ink.

The edges of the stone are very apt to soil, and generally require to be wiped with an old sponge or rag, after the rolling in. They must also frequently have an application of acid and gum, and sometimes be rubbed with pumice-stone. Chalk drawings are much the most difficult to print. After this general description of the printing, the following development of the principles on which it is regulated, and notice of the difficulties which arise in its progress, will be found useful.

An ink which is too thin, and formed of a varnish not sufficiently burnt, will soil the stone, notwithstanding the proper precautions are taken of wetting the stone, and preparing it properly with acid and gum.

Ink which is too stiff, will tear up the lighter tints of the chalk from the stone, and thus destroy the drawings. The consideration of these circumstances, leads us at once to the principles of the printing. These accidents arise at the extreme points of the scale, at which the printing-inks can be used; for it is evident, that the only inks which can be employed, are those which are between these points—that is thicker than that which soils the stone, and, at the same time, thinner than that which takes up the drawing. Lithographers are sometimes unable to print in very hot weather; the reason of this may be deduced from the above. Any increase of temperature will diminish the consistency of the printing-ink; the stone will, therefore, soil with an ink which could be safely used at a lower temperature; hence a stiffer ink must be used. Now if the temperature should increase so much that the stone will soil with any ink at all less thick than that which will take up the drawing, it is evident that the printing must cease till a cooler temperature can be obtained; for, as the drawing-chalk is affected equally with the printing-ink, the same ink will tear up the drawing at the different degrees of temperature. This, though it sometimes occurs, is a rare case; but it shows that it is desirable to draw with a chalk or ink of less fatness in summer than in winter; and, also, that if the printing-room be in winter artificially heated, pains should be taken to regulate the heat as equally as possible.

TO FORGE STEEL.

To the Editor of the Penny Mechanic and Chemist.

Sir,—In the "Penny Magazine," Part xxviii., page 231, I find a paper "On the Preparation of Dies for Coins and Medals," in which it is stated, that the steel, of which the dies are made, is forged at a high heat. It is then brought into a *soft* state by a delicate process of annealing, which is thus described:—The steel is heated to that point known among workers in metal as the *bright cherry red*, and subsequently imbedded in a crucible containing coarsely-pounded animal charcoal; but whether the heat is continued, or the charcoal merely applied to exclude the atmosphere, does not clearly appear. Now, Sir, this mode of working steel is entirely at variance with the experience and practice of men of plain common sense; but, appearing in a periodical professedly got up for the mental improvement of the working classes, sanctioned, moreover, by the Society for the Diffusion of Useful Knowledge, I have thought it worth while to call the attention of such of your readers as are conversant with the subject, to this very novel mode of working, or, more correctly speaking, forging steel at a *high heat*, and then annealing it by a process very nearly allied to case-hardening. The rationale appears to be, first to burn out the carbon of the steel, and then re-impart it; but this cannot be called annealing, the object of which is, to get rid of all inequalities in the texture of the steel, for which animal carbon is supposed to be inapplicable. Much more rational is the mode enjoined for testing the texture of the steel—viz. by washing over the surface with a little dilute aquafortis, which instantly detects the presence of pins of iron, or any other irregularity of composition.

I remain yours, &c.,
An Amateur Mechanic.

TO WELD CAST STEEL.

To the Editor of the Penny Mechanic and Chemist

Sir,—In Dr. Rees' "Cyclopædia," it is stated that, if a bar of iron be heated to redness, and the surface slightly touched with sulphur, the iron will be melted; also, that the bar should be held over a tub of water, and the fluid metal allowed to drop therein, and the buttons of metal collected when cold. Iron, thus treated, is asserted to be easily melted at a lower heat than is required to run lead!

In a contemporary scientific journal, I find the following composition recommended to be used in welding cast steel:—Borax, ten parts, and sal-ammoniac, one part, are to be roughly ground together, and then fused in a metal-pot over a clear fire; observing to continue the heat till the liquid appears clear. The composition is then to be poured out to cool and concrete; afterwards being ground to a fine powder, it is ready for use, which is thus described:—The steel to be welded, is raised to a heat which may be expressed by *bright yellow*; it is then to be dipped in the welding powder, and again placed in the fire, until it attains the same degree of heat as before: it may then be submitted to the action of the hammer. This composition, I presume, refers to welding cast steel to iron, as well as to cast steel. I give it as I find it; and, as a matter of considerable importance to mechanics, I solicit the attention of your readers, and shall feel obliged by an explanation of the *rationale* of both processes.

I remain yours, &c.,
An Amateur Mechanic.

HISTORY OF MEDALS.

(Continued from page 285.)

No change took place in the Roman coinage, from the time that the *as* fell to half-an-ounce, to the days of Pliny: but Mr. Pinkerton observes, that, before the time of Julius Cæsar, yellow brass began to be used, and was always looked upon to be double the value of Cyprian or red copper. There are but few coins in large brass immediately before Julius Cæsar, or even belonging to that emperor; but from the time of Augustus downward, the large coins are all found of brass, and not one of them copper. The largest of what are called the middle size, are all of yellow brass; and the next size, which is the *as*, and weighs half-an-ounce, is universally copper. What the ancients named orichalcum, or what we call brass, was always looked upon to be greatly superior in value to the *æs* Cyprium. Procopius, speaking of a statue of Justinian, tells us, that brass, inferior in colour to gold, is almost equal in value to silver. The mines of native brass were very few in number, and were owing entirely to the singular combination of copper and lapis calaminaris in the bowels of the earth, which very seldom occurs; and the ancients were very far from being well acquainted with the me-

thod of combining these two bodies artificially; so that yellow brass was always esteemed at double the value of copper; and hence, in the ancient coinages, the brass and copper pieces were kept as distinct as those of gold and silver.

Mr. Pinkerton challenges to himself the discovery, that the imperial sestertius was of brass; and is at considerable pains to bring proofs of it. Besides the testimony of Pliny, which of itself would be decisive, this is supported by the strongest collateral evidence of other authors. From a passage in "Julius Africanus," who wrote the Ιατρικα, or "Treatise on Medicine," it appears that the nummus or sestertius weighed an ounce, and, of consequence, that it could not be silver but brass; and all the large imperial Roman coins weigh an ounce. We know not the age in which Julius Africanus lived; and, as he makes the denarius to contain sixteen ases, he must have been before the age of Gallienus, when it had sixty. Gronovius supposes him to have been the same mentioned by Eusebius. This author speaks of a Julius Africanus who lived in the time of Heliogabalus, and whom Mr. Pinkerton supposes to have been the same with him above mentioned.

The sestertius underwent no change till the time of Alexander Severus, when it was diminished by one-third of its weight. Trajanus Decius was the first who coined double sestertii or quinarii, of brass; but from the time of Trebonianus Gallus to that of Gallienus, when the first brass ceases, the sestertius does not weigh above the third part of an ounce; the larger coins are accounted double sestertii; and after the time of Gallienus, it totally vanishes. In the times of Valerian and Gallienus, we find a new kind of coinage, mentioned by the name of denarii æris, or Philippi ærei. Two sizes of denarii began to be used in the time of Caracalla; the larger of six sestertii, twenty-four assaria, the smaller of four sestertii, or sixteen assaria, as usual. In the time of Pupienus, the latter was reduced to such a small size, as not to weigh more than thirty-six grains; though in Caracalla's time it weighed fifty-six. After the time of Gordian III., the smaller coin fell into disuse, as breeding confusion. The larger denarius of six sestertii, though diminished at last to the size of the early denarius, still retained its value of six sestertii or twenty-four assaria. The Philippus æreus came, at length, in place of the sestertius. It was also called denarius; from which we may learn, not only their size, but that they were in value ten assaria, as the first denarius. In the reign of Dioclesian, the place of the sestertius was supplied by the follis; that emperor having restored the silver coin to its purity, and likewise given this form to the copper. But it would seem that this restoration of the coinage only took place towards the end of his reign; whence we have but few of his silver coins, and still fewer of the follis, though the denarii ærei continue quite common down to the time of Constantine. The follis of Dioclesian seems to have weighed above half-an-ounce; and Mr. Pinkerton is of opinion, that Dioclesian designed this coin to supply the place of the denarius æreus; which, of course, was worth ten assariæ, and six of them went to the silver denarius. From this time the assarium diminishes to the size of thirty grains; and, soon after the follis appeared, the denarius æreus was entirely dropped, the former having gradually supplied its place. Some mints appear to have retained the use of the denarius longer than others; and in some the change was preceded, and gradually brought in, by washing the follis with silver or tin, as the denarius had formerly been. Pieces of this kind occur in the times of Dioclesian, Maximian I. and II., and Constantius I.—that is, for about ten years after the follis made its appearance. Some countries, however, retained the denarius æreus, others the follis, and some had a medium betwixt the two, or the follis washed, in imitation of the denarius.

Towards the end of the reign of Constantine I., a new coinage was introduced throughout the whole empire. The follis coined by this prince was of half-an-ounce weight; twenty-four of them going to the milliarensis, or larger silver coin. The word follis signifies also a purse, in which sense we sometimes find it mentioned in the Byzantine history. The common follis of silver, when it occurs by itself, means a purse of 250 milliarenses, as the sestertium was 250 denarii; and by a law of Constantine I., every man paid to the state a follis or purse, according to his income. The method of counting by purses continues in Turkey to this day.

The dupondius was only half the value of the sestertius, or about one penny sterling; and before the yellow brass appeared, it seems to have been struck upon copper, and double the size of the *as*. There are some of this coin, struck in the time of Julius Cæsar, in yellow brass, weighing half-an-ounce, with a head of Venus Victrix upon one side; on the reverse, a female figure, with serpents at her feet; while others have a Victory on the re-

verse, with Q. Oppius Pr. After the time of Augustus, the dupondius was struck in yellow brass; which Pliny tells us was also the case in his time. The word dupondiarius seems to have been used by Pliny, and adopted, not to express that the coin was dupondius, but that it was of dupondiary value. Neither was the former word confined to signify double weight, but was used also for double length or measure, as in the instance of dupondius pes, or two feet, &c. In the imperial times, therefore, dupondius was used, not to signify a coin of double the weight of the *as*, but of double the value. It was one of the most common of the Roman coins; and seems to have been very common even in Constantinople. In the time of Justinian, it seems there was a custom of nicknaming young students of the law *dupondii*, against which the emperor made a law; but it is not known what gave rise to the name. The dupondius, though of the same size with the *as*, is commonly of finer workmanship, the metal being greatly superior in value. It continues to be of yellow brass, as well as the sestertius, to the time of Gallienus; but the *as* is always in copper.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Friday, August 26. Nomination of Candidates for the Committee. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, August 18, J. Humffreys Parry, Esq., on Contemporaneous British Oratory. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, August 15, James Smith, Esq., on Political Economy. At a quarter-past eight o'clock.

QUERIES.

What works are published, treating music as a science; and how can we best study it with regard to composition, thorough bass, &c.?

A Subscriber.

I have lately read an account of Sir Isambard Brunel's celebrated block machinery at Portsmouth, in which it is stated, that "the iron pins are prepared for turning, by a small hole being punched in the cylindric end of it; a simple tool being used to insure the punch being set truly in the centre of the end of the pin." (See Rees' "Cyclopædia," vol. xxii.) I shall feel greatly obliged to any reader who will describe this or a similar tool, in the pages of the Penny Mechanic.

Amateur Mechanic.

How a watch-maker's common lathe (such as that described in No. 80), may be made to have a "regular rotary motion," instead of moving backwards and forwards? A pedal and fly-wheel could not, I suppose, be adapted to such small instruments? What would be the cost of a watch-maker's regular lathe, with eccentric chuck? Also, in Bennet's gold-leaf electrometer, how are the gold leaves attached to the wire that supports them?

X. Y. Z.

How to make copying-ink; also the exact method of preparing it; or where can I obtain such recipe?

J. J.

How to make paper of a pink colour; also, a good yellow, and what is termed emerald green? How is the colour laid on?

A. S. F.

What kind of wood burnt into charcoal, do gunpowder-makers use; and whether liquid nitre or saltpetre is used?

B. N.

[The charcoal used in gunpowder is distilled in iron vessels, from willow, alder, and some other woods.]

ANSWERS TO QUERIES.

"James Sheppard." The composition which you designate *solder*, used by the smiths to harden iron, is, I suspect, erroneously printed for some other expression. If you allude to case-hardening iron, this may be done superficially by prussiate of potash, which converts the surface of the iron into steel, but the effect is very slight; however, it is useful, in some cases, where the tedious process of cementation in an air-tight box, can be dispensed with, and the article is not intended to be subjected to much friction.

Amateur Mechanic.

"P. T." The specific gravity of muriatic acid gas, is 1.2847; and it consists of equal volumes of chlorine and hydrogen. It absorbs water so instantly, as at once to melt ice. Water absorbs 480 times of its bulk of the gas, becoming 1 2109.

TO CORRESPONDENTS.

W. Jones.—*Chlorine gas destroys the volatile effluvia of putrefaction and infection; and a solution of the chloride of lime is bleaching powder, and employed in fabrics. A table-spoonful in a wine-glass of water, spread on a plate, destroys all infection, and purifies the air of sick chambers, infected houses, removes smells from drains, privies, &c.*

J. Williams.—*Attempts to produce hydrogen, oxygen, &c., by generating them under the pressure of strong glass tubes, and condensing with cold, did not succeed.*

A. M. W.—*The greatest natural cold known, is 50° below zero.*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 97, THIRD SERIES. | SATURDAY, AUG. 20, 1842. | No. 345, OLD SERIES.

ELECTRICAL EXPERIMENTS.

FIG. 1.

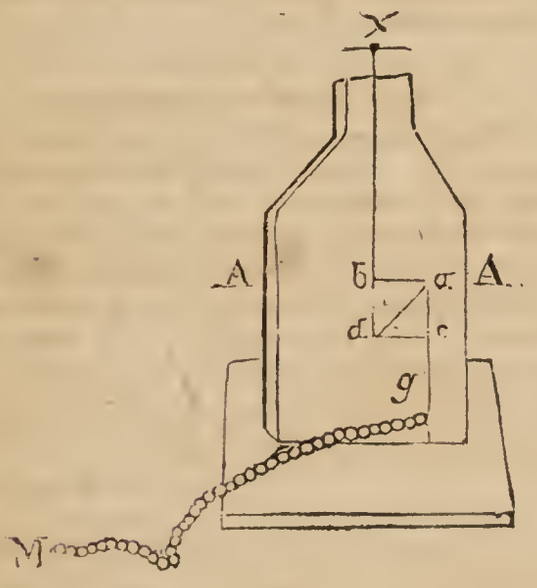


FIG. 2.

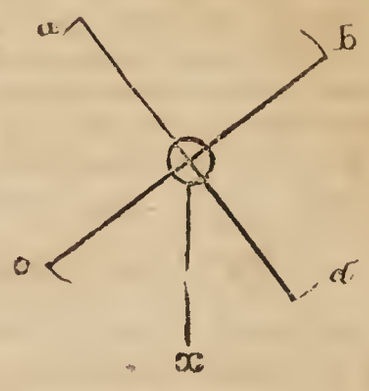


FIG. 3.

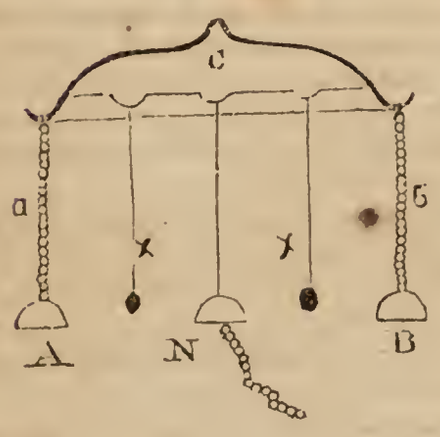
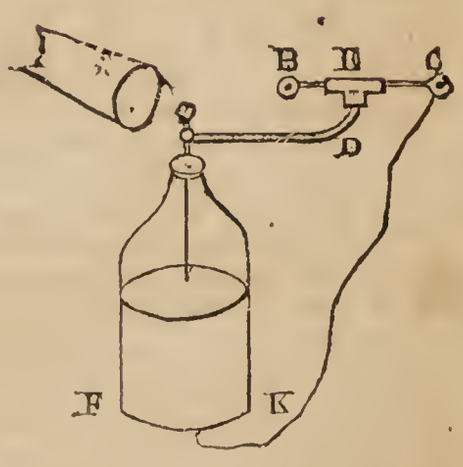


FIG. 4.



Vol. VIII.—No. 38.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ELECTRICAL EXPERIMENTS.

(Continued from page 287.)

(See Engraving, front page.)

Exp. 21. A A, fig. 1, is a board representing the gable end of a house, which is fixed on another board, B; *a b c d* is a square hole, to which a piece of wood is fitted. *e e* represents a wire fixed diagonally on the wood, *a b c d*; *f*, terminated by a knob, *x*, to represent a weather cock on the wire, *g*, is fixed to the board, *a*. In the state in which it is drawn in the figure, there is an interruption in the conducting rod; accordingly, if the chain, M, be connected with the outside of a Leyden jar, and the jar be discharged through *x*, by bringing one part of the discharging rod to the knob of the Leyden jar, and the other to within an inch or two of *x*, the piece of wood, *a b c d*, will be thrown out with violence. By this experiment, if the wire, *f*, had been continued to the chain, the electric fluid would have run through it, without disturbing the loose board; for if the piece of wood be taken out, and the part, *a*, be put to the part, *b*, then *d* will come to *c*, and the conducting rod will be complete, and continued from *x*, through *f* and *g*; and now the jar may be discharged as often as you please, but the wood will remain in its place; because the electric fluid runs through the wire, *f* and *g*, and makes its way, by the chain, to the outside of the jar.

22. Take a glass tube about thirty inches long, and about two inches in diameter, and nearly exhausted of air, likewise capped at both ends with brass; the ends are to be connected, by means of a chain, with the positive and negative part of the machine; and in a darkened room you will see, when the machine is worked, all the appearance of the Northern Lights. It is necessary nearly to exhaust the tube, because the air in its natural state is a very bad conductor of the electric fluid; but when it is perhaps rendered some hundreds of times rarer than it usually is, the electric fluid darts from one cap to the other with the greatest ease.

23. If two sharp-pointed wires be bent with the four ends at right angles, but pointing different ways, and they be made to turn upon a wire, X, fig. 2, fixed on the conductor; the moment it is electrified, a flame will be seen at the points, A B C D; the wire will begin to turn round in the direction opposite to that in which the points are turned, and the motion will become very rapid. If the figures of horses cut in paper, be fastened upon the wires, the horses will seem to pursue one another; and this is called the electrical race-horse: on this principle many other amusing and beautiful experiments may be made.

24. Fig. 3 is an apparatus consisting of three bells, suspended from a brass wire; the two outer ones by small brass chains, the middle bell, and the two clappers, X X, are suspended on silk. From the middle bell is a chain, N, which goes to the table or any other conducting substance. The bells are now to be hung, by C, on the conductor, and the electrical machine is to be put in motion. The clappers will go from bell to bell, making very pretty music; the electric fluid will run down the chain, *a* and *b*, to the bells, A and B; these, having more than their natural quantity, attract the clappers, X X, which take a portion from A and B, and carry it to the centre bell, N; and this, by means of the chain, conveys it to the earth. The same effect could not be produced if the clappers were not suspended on silk; nor would it be produced if the chain were taken away from the bell, N, because then there would be no way left to carry off the electric fluid to the earth.

25. Another amusing experiment is thus shown: Let there be two wires placed exactly one above another, and parallel; the upper one must be suspended from the conductor, the other is to communicate with the table; a light image, placed between these, will, when the conductor is electrified, appear like a rope-dancer. Cut a piece of sheet-brass in the shape of a fish; one end is a sort of obtuse angle, the other is acute; if the large end be presented towards an electrified conductor, it will fix to it, and from its wavering motion it will appear to be animated.

26. I make the arm, D, fig. 4, of glass, to proceed from a socket on the wire of the electrical jar, F; to the top of the glass arm is cemented another brass socket, E, through which a wire with balls, B and C, at each end, will slide backwards and forwards; so that it may be brought to any distance from the ball, A, which is on the wire connected with the inside of a jar. When the jar, F is set either in contact with, or very near, the conductor, as it is represented in the figures, and the ball, B, is set at the distance of the eighth of an inch from the ball, A; let a wire, C K, be fixed between the ball, C, and the outside coating of the jar: then, as soon as the machine is worked, the jar cannot be charged beyond a certain point; for when the charge is strong enough to pass from A to the ball, B, the discharge will take place, and the electric fluid collected in the inside, will pass through the wire, C K, to the outside coating.

This machine is called, "Lane's Discharging Electrometer," from the name of the person who first invented it, and is useful in applying the electric shock to medical purposes, as will be seen. If a person stand on a stool with glass legs, and hold the chain from the conductor while the machine is worked a few minutes, the pulse will be increased—that is, it will beat more frequently than it did before. From this circumstance physicians have applied electricity to the cure of many disorders—in some of which their endeavours have been unavailing, in others very complete; in some cases, they took sparks from their patients, in others they gave shocks. There are machines and apparatus made entirely for medical purposes, but every end may be answered by the instrument just referred to. Suppose the electrometer to be fixed to a Leyden jar, and the knob at A, to touch the conductor, and the knob, B, to be so far off as the shocks are meant to be weak or strong; one chain or wire is to be fixed to the ring, C, of the electrometer, and another wire or chain to the outside coating; the other ends of these two wires are to be fastened to the two knobs of the discharging rod.

Suppose it is wished to electrify the knee, for instance; the balls of the discharging rod are to be brought close to the knee—one on the one side, and the other on the opposite side; and at every discharge of the Leyden jar, superabundant electricity from withinside, will pass from the knob at A, to the knob, B, and will pass through the wire and the knee in its way to the outside of the jar, to restore to both sides an equilibrium. If it be wished to electrify the arm, the assistance of a friend must be obtained; who will, by means of two instruments called directors, be able to conduct the fluid to any part of the body. A director consists of a knobbed brass wire, which, by means of a brass cap, is cemented to a glass handle; so the operator, holding these directors by the extremities of the glass handle, brings the balls to which the wires or chains are attached, into contact with the extremities of that part of the body of the patient through which the shock is to be sent. If rheumatic pains be felt between the elbow and wrist, and a person hold one director at the elbow and another about the wrist; the shocks will pass through, and perhaps will be found useful in removing the complaint. It is by no means necessary to stand on the insulated stool to have this operation performed. When shocks are administered, the person who receives them may stand as he pleases, either on the stool or on the ground; the electric fluid, taking the nearest passage, will always find the knob of the other director, which leads to the outside of the jar. In the case of shocks, it is quite unnecessary to make the body bare, unless the covering be very thick; but when sparks are to be taken, then the person from whom they are drawn, must be insulated, and the clothes should be stripped off the part affected. Shocks have been found useful in paralytic disorders; in contraction of the nerves, in sprains, and many other cases; but great attention is necessary in regulating the force of the shock, because, instead of advantage, mischief may occur, if it be too violent. There is less danger in sparks, for unless it be in very tender parts, as the eye, there is no great risk in taking sparks; and they have proved effectual in many complaints, as also in cases of deafness, ear-ache, tooth-ache, swellings inside the mouth, &c. Strong sparks might injure the ear, and therefore the spark should be taken from that part with a pointed piece of wood, to which it comes in a stream; or, when sparks are taken, a very small brass ball is used, because, in proportion to the size of the ball, is the size of the spark. W. HOPKINSON.

HISTORY OF MEDALS.

(Continued from page 296.)

THE imperial *as*, or assarium, was worth only a halfpenny. At first it weighed half-an-ounce, and was always of copper, till the time of Gallienus, when it was made of brass, and weighed only the eighth part of an ounce. From the time of Gallienus to that of Dioclesian, it continued to diminish still more, the size being then twenty to one ounce. This was the same with the lepta, or smallest coins, but the *νουμια*, which weighed only ten grains.

The parts of the *as* occur but seldom: which may, indeed, be well expected, considering the low value of it; though there still occur some of those called semis, triens, quadrans, sextans, and uncia, coined in the times of Nero and Domitian. There is no small brass from the time of Pertinax to that of Gallienus, excepting that of Trajanus Decius; but, in the time of Gallienus it becomes extremely common; and the coins of small brass, as well as the larger, are always marked S. C., such as want it being universally accounted forgeries; and were plated with silver, though the plating be now worn off. The small pieces struck for slaves during the time of the saturnalia, must

also be distinguished from the parts of the *as*. The S. C. upon these most probably signifies Saturni Consulto, and were struck in ridicule of the true coins, as the slaves on that occasion had every privilege of irony.

The sestertius diminishes from Pertinax to Gallienus so fast, that no parts of the *as* are struck, itself being so small. Trajanus Decius, indeed, coined some small pieces, which went for the semis of the time. The small brass coins under Gallienus, were called assaria, sixty of which went to the silver denarius. They are about the size of the denarius, and some of them occur of the coinage of Gallus and his family, of half that size, which appear to have been struck during the latter part of his reign, when the assarium was diminished to a still smaller size. It is probable, however, that some of these very small coins had been struck in all ages of the empire, in order to scatter among the people on solemn occasions. Mr. Pinkerton is of opinion that they are the missilia, though most other medallists think that they are medallions. "But if so (says our author,) they were certainly called missilia à non mittendo; for it would be odd if fine medallions were scattered among the mob. It is a common custom just now to strike counters to scatter among the populace on such occasions, while medals are given to peers of the kingdom; and we may very justly reason from analogy on this occasion."

The assarion or lepton of the Constantinopolitan empire was, as we have already observed, one of the smallest coins known in antiquity, weighing no more than 20 grains; and the *noumia* were the very smallest that have reached our times, being only one-half of the former. By reason of their extreme smallness, they are very scarce; but Mr. Pinkerton informs us, that he has in his possession a fine one of Theodosius II. which has on it the emperor's head in profile. Theodosius P. F. A. V.; on the reverse a wreath, having in the centre, VOT. XX. MULT. XXX.

The principal coin of the lower empire was the follis, which was divided into a half and quarter, named ἡμισοφολεος and τεταρτον; the latter of which is shown by Du Cange to have been a small brass coin, as the other is supposed to have been by Mr. Pinkerton. Besides these, the follis was divided into eight oboli, sixteen assaria or lepta, and thirty-two noumia, though in common computation, it contained forty of these last. This coin, notwithstanding so many divisions, was of no more value than a halfpenny.

Mr. Pinkerton controverts an opinion, common among medallists, that the largest brass coin or follis of the lower empire had forty small coins, expressed by the letter M upon it; the next had thirty, expressed by the letter A; the half by the letter K; and the quarter marked I, which contained only ten. Mr. Pinkerton informs us, that he has three coins of Anastasius, all marked M. in large; one of them weighs more than half-an-ounce; the second forty grains less; and the third 160 grains, or one-third of an ounce; but the size is so very unequal, that the last, which is very thick, does not appear above half the size of the first. There are pieces of Justinian which weigh a whole ounce; but the size of copper was increased as the silver became scarcer; and the value of the coinage cannot be deduced from the weight of the coins, as it is plain that our own coinage is not of half the value with regard to the metal. A great number of medallions were struck by Constantius II. but there is no other copper larger than the half-ounce, excepting that of Anastasius, when the follis began to be struck larger. All medallists allow the others to be medallions.

The metal employed in making these very small coins, though at first of brass, was always a base and refuse kind; but copper is generally made use of in the parts of the *as* from the earliest times to the latest; and if brass be sometimes employed, it is never such as appears in the sestertii and dupondiarii, which is very fine and beautiful, but only the refuse. "Yellow brass of the right sort (says Mr. Pinkerton), seems totally to have ceased in the Roman coinage with the sestertius, under Gallienus, though a few small coins of very bad metal appear under that hue as late as Julian II."

Silver was coined in Rome only as late as the 485th year of the city, or 266 B. C. Varro indeed speaks of silver having been coined by Servius Tullius, and the libella having been once in silver; but Pliny's authority must be accounted of more weight than that of this author, as he mistakes the λιτρα of Sicily for Roman coins, having been current at Rome during the time of the first Punic war. Even Pliny, according to our author, very frequently mistakes with regard to matters much antecedent to his own time; and among the moderns he criticises severely Erasmus and Hume. "Erasmus (says he), who had been in England for some time, talks of leaden money being used here." Not even a leaden token was struck in the reign of Henry VIII.; yet his authority

has been followed with due deference to so great a name; for how could Erasmus, who must have seen the matter with his own eyes, assert a direct falsehood? To give a later instance in a writer of reputation, Mr. Hume, in Vol. VI. of his history, has these words, in treating of the reign of James I. "It appears that copper halfpence and farthings began to be coined in this reign. Tradesmen had commonly carried on their retail business by leaden tokens. The small silver penny was soon lost; and at this time was nowhere to be found." Copper halfpence and farthings were not struck till Charles II. 1672: there were small tokens for farthings struck in copper by James I., but not one for the halfpenny. The silver farthings had ceased with Edward VI., but the silver halfpence continued the sole coins till Edward II. It was by copper tokens that small business was carried on. The silver penny was much used till the end of the reign of George I.; and so far from being nowhere to be found, is superabundant in every reign since that period, not excepting even the reign of George III. From these instances the reader may judge, how strangely writers of all ages may blunder, when treating of a subject of which they are entirely ignorant.

PROPERTIES OF ATMOSPHERIC AIR.

(*Continued from page* 292.)

That the atmosphere contains water, has been always known. The rain and dew which so often precipitate from it, the clouds and fogs with which it is often obscured, and which deposit moisture on all bodies exposed to them, have demonstrated its existence in every age. Even when the atmosphere is perfectly transparent, water may be extracted from it in abundance by certain substances. Thus, if concentrated sulphuric acid be exposed to air, it gradually attracts so much moisture, that its weight is increased more than three times: it is converted into diluted acid, from which the water may be separated by distillation. Substances which have the property of abstracting water from the atmosphere, have received the epithet of *hygroscopic*; because they point out the presence of that water. Sulphuric acid, the fixed alkalies, muriate of lime, nitrate of lime, and in general all deliquescent salts, possess this property. The greater number of animal and vegetable bodies likewise possess it. Many of them take water from moist air, but give it out again to the air when dry. These bodies augment in bulk when they receive moisture, and diminish again when they part with it. Hence some of them have been employed as *hygrometers*, or measurers of the quantity of moisture contained in the air around them. This they do by means of the increase or diminution of their length, occasioned by the addition or abstraction of moisture. This change of length is precisely marked by means of an index. The most ingenious and accurate hygrometers, are those of Saussure and Deluc. In the first, the substance employed to mark the moisture is a human hair, which, by its contractions and dilatations, is made to turn round an index. In the second, instead of a hair, a very fine thin slip of whalebone is employed. The scale is divided into 100o. The beginning of the scale indicates extreme dryness, the end of it indicates extreme moisture. It is graduated by placing it first in air made as dry as possible by means of salts, and afterwards in air saturated with moisture. This gives the extremes of the scale, and the interval between them is divided into 100 equal parts.

The water, which constitutes a component part of the atmosphere, is chemically combined with air; but it exists in two different states. A small portion is held in solution in the state of water, but by far the greater proportion is in the state of an elastic fluid, whose specific gravity is to that of air as 10 to 12, and chemically combined with air in the same manner as one gas is combined with another. As the quantity of the water contained in the atmosphere varies considerably, it is impossible to ascertain its amount with any degree of accuracy.

The existence of carbonic gas as a constituent part of the atmosphere, was observed by Dr. Black immediately after he had ascertained the nature of that peculiar fluid. If we expose a pure alkali or alkaline earth to the atmosphere, it is gradually converted into a carbonate by the absorption of carbonic acid gas. This fact, which had been long known, rendered the inference that carbonic acid gas existed in the atmosphere, unavoidable, as soon as the difference between a pure alkali and its carbonate had been ascertained to depend upon that acid. Not only alkalies and alkaline earths absorb carbonic acid when exposed to the air, but several of the metallic oxides also.

Carbonic acid gas not only forms a constituent part of the atmosphere near the surface of the earth, but at the greatest heights which the industry of man has been able to penetrate. Saussure found

it at the top of Mount Blanc, the highest point of the old continent; a point covered with eternal snow, and not exposed to the influence of vegetables or animals. Lime-water diluted with its own weight of distilled water, formed a pellicle on its surface after an hour and three-quarters' exposure to the open air on that mountain; and slips of paper moistened with pure potash, acquired the property of effervescing with acids, after being exposed an hour and a half in the same place. This was at a height no less than 15,668 feet above the level of the sea. Humboldt has more lately ascertained the existence of this gas in air, brought by Mr. Garnerin from a height not less than 4280 feet above the surface of the earth, to which height he had risen in an air-balloon. This fact is a sufficient proof that the presence of carbonic acid in air does not depend upon the vicinity of the earth.

Now as carbonic acid gas is considerably heavier than air, it could not rise to great heights in the atmosphere, unless it entered into combination with the air. We are warranted, therefore, to conclude that carbonic acid is not merely mechanically mixed, but that it is chemically combined with the other constituent parts of the atmosphere. It is to the affinity which exists between carbonic acid and air, that we are to ascribe the rapidity with which it disperses itself through the atmosphere, notwithstanding its great specific gravity. Fontana mixed 20,000 cubic inches of carbonic acid gas with the air of a close room, and yet half-an-hour after he could not discover the traces of carbonic acid in that air. Water impregnated with carbonic acid, when exposed to the air, very soon loses the whole of the combined gas. And when a phial full of carbonic acid gas is left uncorked, the gas, as Bergman first ascertained, very soon disappears, and the phial is found filled with common air.

It is owing to this strong affinity between air and carbonic acid gas, that it is so difficult to detect the presence of that gas in air by the common tests. Atmospheric air does not render lime-water turbid, though agitated with it ever so long, or made to pass through it in ever so great a quantity. Neither has it any effect upon the most delicate vegetable blues. The great quantity of air with which it is combined, envelopes it in such a manner that these bodies are not powerful enough to abstract it. We must employ for that purpose substances which have a very strong affinity for that acid—as the alkalies, milk of lime, &c. These substances detect its presence, by acquiring the property of effervescing with acids.

The difficulty of separating this gas from air has hitherto prevented the possibility of determining with accuracy the relative quantity of it in a given bulk of air; but from the experiments which have been made, we may conclude with some degree of confidence, that it is not very different from 0.01. From the experiments of Humboldt, it appears to vary from 0.005 to 0.01. This variation will by no means appear improbable, if we consider that immense quantities of carbonic acid gas must be constantly mixing with the atmosphere; as it is formed by the respiration of animals, by combustion, and several other processes which are going on continually. The quantity, indeed, which is daily formed by these processes is so great, that at first sight it appears astonishing that it does not increase rapidly. The consequence of such an increase would be fatal; as air containing 0.1 of carbonic acid extinguishes light, and is noxious to animals. But there is reason to conclude, that this gas is decomposed by vegetables as rapidly as it forms.

CAUSES OF RAIN.

(Continued from page 291.)

The raining of frogs is a thing not less wonderful in the accounts of authors who love the marvellous, than those of blood or stones; and this is supposed to happen so often, that there are multitudes who pretend to have been eye-witnesses of it. These rains of frogs always happen after very dry seasons, and are much more frequent in the hotter countries, than in the cold ones. In Italy they are very frequent; and it is not uncommon to see the streets of Rome swarming both with young frogs and toads in an instant, in a shower of rain; they hopping everywhere between the people's legs as they walk, though there was not the least appearance of them before. Nay, they have been seen to fall through the air down upon the pavements. This seems a strong circumstance in favour of their being rained down from the clouds; but, when strictly examined, it comes to nothing; for these frogs that are seen to fall, are always found dead, lamed, or bruised by the fall, except close under the walls of houses, from the roofs and gutters of which, they have accidentally slipped down. Some people, who love to add to strange things, yet stranger, affirm that they have had the young frogs fall into their hats in the midst of an open field; but this is idle

and wholly false. Others, who cannot agree to their falling from the clouds, have tried to solve the difficulty of their sudden appearance, by supposing them hatched out of the egg or spawn by these rains. Nay, some have supposed them made immediately out of the dust: but there are unanswerable arguments against all these suppositions. Equivocal generation, or the spontaneous production of animals out of dust, is now wholly exploded. The fall from the clouds must destroy and kill these tender and soft-bodied animals; and they cannot be at this time hatched immediately out of eggs; because the young frog does not make his appearance from the egg in form, but has its hinder legs enveloped in a skin, and is what we call a tadpole; and the young frogs are at least a 100 times larger at the time of their appearance, than the egg from which they should be hatched. It is beyond a doubt that the frogs which make their appearance at this time, were hatched and in being long before, but that the dry season had injured them, and kept them sluggishly in holes or coverts; and that all the rain does is the enlivening them, giving them new spirits, and calling them forth to seek new habitations, and enjoy the element they were destined in great part to live in. Theophrastus, the greatest of all the naturalists of antiquity, has affirmed the same thing. We find that the error of supposing these creatures to fall from the clouds, was as early as that author's time; and also that the truth in regard to their appearance, was as early known, though in the ages since, authors have taken care to conceal the truth, and to hand down to us the error. We find this venerable sage, in a fragment of his on the generation of animals, which appear on a sudden, bantering the opinion, and asserting that they were hatched and living long before. The world owes, however, to the accurate Signior Ridi, the great proof of this truth, which Theophrastus only has affirmed; for this gentleman, dissecting some of these new appearing frogs, found in their stomachs herbs and other half-digested food; and, openly showing this to his credulous countrymen, asked them whether they thought that Nature, which engendered, according to their appearance, these animals in the clouds, had also been so provident as to engender grass there for their food and nourishment? To the raining of frogs, we ought to add the raining of grasshoppers and locusts, which have sometimes appeared in prodigious numbers, and devoured the fruits of the earth. There has not been the least pretence for the supposing, that these animals descended from the clouds, but that they appeared on a sudden, in prodigious numbers. The naturalist, who knows the many accidents attending the eggs of these and other like animals, cannot but know, that some seasons will prove particularly favourable to hatching them; and the prodigious number of eggs that many insects lay, could not but every year bring us such abundance of the young, were they not liable to many accidents, and had not provident Nature taken care, as in many plants, to continue the species by a very numerous stock of seeds, of which, perhaps, not one in 500 need take root, in order to continue an equal number of plants. As it is this, also, in regard to insects, it cannot but happen that, if a favourable season encourage the hatching of all those eggs, a very small number of which, alone, was necessary to continue the species, we must, in such seasons, have a proportionate abundance. There appeared, about fifty years ago, in London, such a prodigious swarm of the little beetle, called the lady cow, that the very posts in the streets were everywhere covered with them. But thanks to the progress of philosophy among us, we had nobody to assert that it rained cow ladies, but contented ourselves with saying, that it had been a favourable season for their eggs.

(To be continued.)

Marshall's Flax Mills at Leeds.—The following particulars respecting this stupendous building have been furnished by an eye-witness, who was permitted to inspect it a few weeks ago:—The building is 132 yards long, and 72 yards wide (inside measure)—one story, or 20 feet high. The roof consists of 72 brick arches, supported on 72 iron pillars of the Corinthian order, and secured together by strong ironwork. The brick roof has a thick coating of composition, to prevent the water from coming through, and is covered with earth, from which has sprung up a beautiful grass-close. There are 66 glass domes, 48 feet round, 11 feet 6 inches high, containing 10 tons of glass, all iron window-frames. Total weight of roof, 4,000 tons. Cost, with the machinery, upwards of 200,000*l.* There are 4 steam-engines, 100 horse-power each, two 80 or 85 horse-power each—and 1 engine, 7 horse-power; which does nothing but blow either hot or cold air into the room. The building covers more than two acres of ground. It is supposed that 80,000 persons might stand in the room, 60,000 on the roof, and 50,000 in the cellar.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Friday, August 26, Nomination of Candidates for the Committee. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, Aug. 25, Richard King, Esq., on Arctic Discovery. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, August 22, Mr. J. Robinson, on Entomology. At a quarter-past eight o'clock.

QUERIES.

Is there any institution in or near the Metropolis, where the subscribers enjoy the use of telescopes of superior powers, suitable for astronomical purposes? J. L. D.

About six months ago, my name was inserted in your valuable Magazine, that I was the maker of seraphine plates. I have received various letters from town and country on the above subject. I have now invented a seraphine, combined with organ-pipes; the organ can be played separate, or combined together, by the use of stops, to bring on at pleasure, with two swell pedals, piano and forte, and produces a fine effect. The above instrument is finished, and can be seen and played on. J. Tully.

30, Bilton Street, Long Acre.

What pressure will tin sustain, if used as a boiler, gradually and suddenly applied? Also, the receipe for staining wood a black colour?

E. G.

How can I bronze soft-soldered articles, made of sheet-copper, a brown colour, or similar to the way the soft-soldered powder-flasks are bronzed at Sheffield? I believe they are done by bronzing, or dipped in some sort of solution. I have tried solution of platinum, and find it turns the copper black. W. W.

ANSWERS TO QUERIES.

"B. G." can moisten the ingredients with a little water, and lay it on the inside of the skins with a brush. I have tried the recipe, and found them keep very well.

The bellows used by glass-blowers, can be bought at Wright's, 63, Long Lane, West Smithfield. They are treble bellows, and the price is 14*s*. The size is two feet by fourteen. He will forward them by sending a money-order.

Brass must be dressed in aqua fortis, to make the pale yellow. After dipping, it must be rinsed in some water, and brushed dry in saw-dust. You may bronze brass with borax and spelter. Mix your spelter and borax in a little water, and lay it on enough for your work; if it do not run to your wish, throw a little dry borax on the spelter when hot. You must heat your work over a forge, or you can do it with the blowpipe, if the work be small. H. J. Bude.

TO CORRESPONDENTS.

Mr. Girett *surely cannot suppose that we can give an opinion of his manuscript and invention, without seeing the one, and having more particulars of the other than are given in his letter. He must bear in mind, too, that nothing of the kind, however useful in itself, can really benefit "the working mechanic," unless it can be obtained at a price which puts it within the reach of those who can scarcely afford a sixpence for any purpose beyond obtaining the necessaries of life.*

The remarks of a Journeyman Mechanic, *are exceedingly good; and if he will send us what he alludes to, we will endeavour, at an early opportunity, to give some attention to the subject.*

J. Willey's *communications are not lost sight of, but we really must apologise for the length of time that has passed since we received them. We will attend to the subject as early as possible.*

In reply to W. C's. *inquiry, we copy the following:—"The power employed in forcing, must evidently surmount the pressure of the whole water in the rising pipe; and (independent of what is necessary for giving the water the required velocity, so that the proper quantity per hour may be delivered) the piston has to withstand a force equal to the weight of a column of water, having the section of the piston for its base, and the perpendicular altitude of the place of delivery above the lower surface of the piston for its height. It is quite indifferent in this respect, what is the diameter of the rising pipe; because the pressure on the piston depends on the altitude of the water only, independent of its quantity. We shall even see that a small rising pipe will require a greater force to convey the water along it to any given height or distance. When we would employ a pump to raise water in a crooked pipe, or in any pipe of moderate dimensions, this form of pump, or something equivalent, must be used. In bringing up great quantities of water from mines, the common sucking pump is generally employed as really the best of them all; but it is the most expensive, because it requires the pipe to be perpendicular, straight, and of great dimensions, that it may contain the piston-rods. But this is impracticable when the pipe is crooked. If the forcing pump, constructed in this manner, be employed, we cannot use forcers with long rods; these would bend when pushed down by their farther extremity. In this case it is usual to employ only a short stiff rod, and to hang it by a chain, and load it with a weight, superior to the weight of the water to be raised by it. The machinery therefore is employed, not in forcing the water along the rising pipe, but in raising the weight which is to produce this effect by its subsequent descent."*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 98, THIRD SERIES. } SATURDAY, AUG. 27, 1842. { No. 346, OLD SERIES.

PATENT PORTABLE PERFORATED ZINC MEAT-SAFES.

Fig. 1.

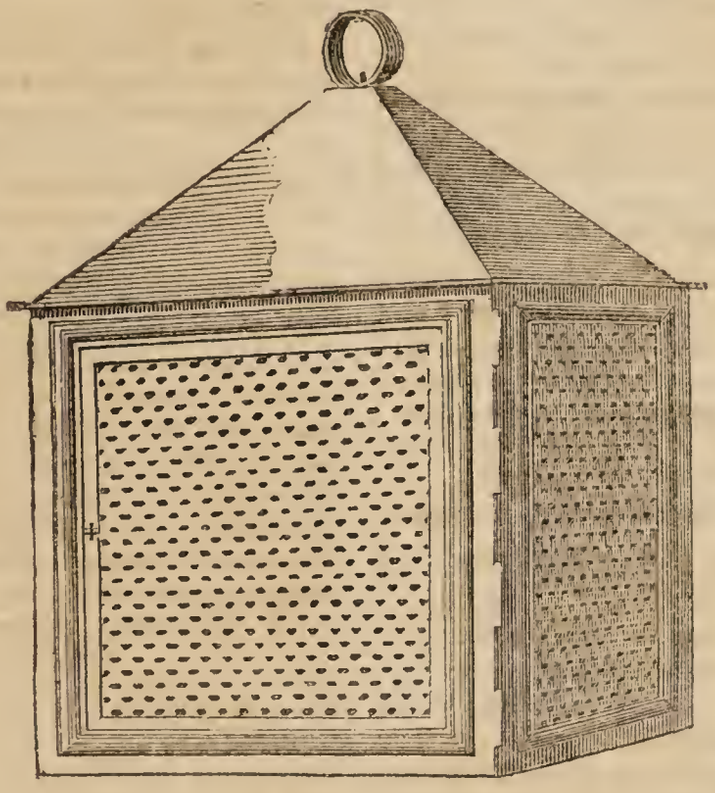


Fig. 2.

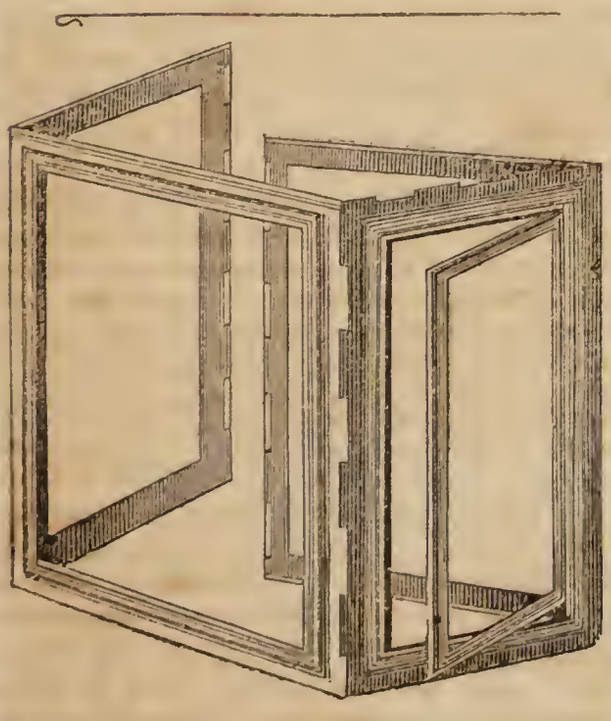
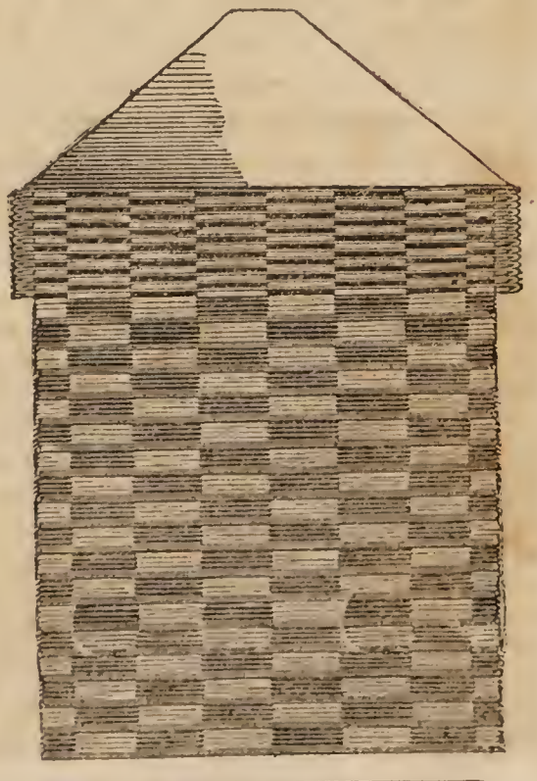


Fig. 3.



Vol. VIII.—No. 39] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

PATENT PORTABLE PERFORATED ZINC MEAT-SAFES.

(See Engraving, front page.)

Fig. 1 shows the meat-safe when fitted up.

Fig. 2 the manner in which it is put together.

Fig. 3 the relative bulk in which eighteen meat-safes can be packed for exportation.

The portable perforated zinc meat-safe, while it obviates the defects of inconvenient bulk and liability to damage, possesses many advantages over any other kind in use. It can, at any moment, be taken to pieces, and packed in so small a compass that eighteen occupy the bulk of one only, as shown in fig. 3. It can always be kept clean by washing with soap and water; is not liable to rust, and requires no painting. This is particularly adapted for warm countries, where, from the heat of the sun, the paint is apt to taint the meat. The purity of the metal also prevents its having any noxious effect on victuals left in it.

FRICTION,

ITS ORIGIN AND EFFECTS ON IRON AXLES.

To the Editor of the Penny Mechanic and Chemist.

SIR,—I have just read in a contemporary journal (the "Practical Mechanic and Engineer's Magazine," pt. x. p. 406), a report of the proceedings of the British Association for the Advancement of Science at the last meeting held at Manchester. Under Section G, I find a very interesting discussion respecting the axles of locomotive engines, referring to the report of M. Francois and Colonel Aubert on the subject of the late accident on the Versailles Railway; who state, that *the fractures of broken axles, instead of having the fibrous appearance of wrought iron, presented the crystalline appearance of cast iron; and this they attributed to a magnetic or electric action, induced by friction in the bearings, and which had changed the molecular structure of the iron.* Professor Vignoles seems disposed to assent to the opinion of the French engineers; and Mr. Fairbairn propounds as a well known fact, that cold swaging—that is, hammering the iron after it has been cooled *below a red heat*—invariably induces a crystalline structure. This doctrine is confirmed by Mr. Nasmyth's statement, who considers that all deteriorations produced by careless forging, are absolutely cured by the process of annealing. Mr. Nasmyth remarked "by this means the injurious effects of injudicious workmanship would be entirely removed, and the fibrous character of the iron restored. He disliked the fashion of referring all unexplained phenomena to magnetism and electricity: *it was merely a cover for ignorance.*" Now, sir, with all due respect for the opinion of a gentleman who stands so high in the profession as Mr. Nasmyth unquestionably does, I must take leave to ask him, whether this wholesale condemnation in lieu of some more feasible theory, does not savour of prejudice? It is easy to use hard words; but, until something more tangible than mere assertion be adduced, I, for one, shall feel inclined to retort the charge, and look upon this retreat as "*a most lame and impotent conclusion.*" In one respect I am inclined to think the French *savans* have fallen into error, inasmuch, that they consider the magnetic or electric action to be induced by friction; whereas, the contrary I apprehend will eventually be found to be the case. It is now some years since I first commenced a series of experiments on the nature and properties of friction, and the results have proved satisfactorily, that electricity is more intimately connected with friction than Mr. Nasmyth seems disposed to admit. I have no disposition to arrogate to myself a character to which I am not fairly entitled, but I submit, the pages of the PENNY MECHANIC, during the past and the present year, offer abundant evidence, that I have, on several occasions, referred to the low state of knowledge respecting the origin and functions of friction; and I can produce written documents, to substantiate that more than fifteen months ago, I had traced friction to its true source, electrical agency. The most puerile and absurd part of the charge brought against the French engineers by Mr. Nasmyth, is in effect this: That they, the authorized agents of Government, not being able to disentangle the intricacies of their inquiry, had assigned certain effects to an inadequate cause merely ad captandum, and as a cover for ignorance. This, to say the least of it, is really a very unfair way of estimating the labours of men of science. I will not trespass farther on your indulgence on the present occasion; as I fear an investigation of the singular properties attributed to *annealing* of iron by Mr. Nasmyth, or the prejudicial effects in relation to strength, consequent on condensing iron by hammer-hardening, pointed out by Mr. Fairbairn, would lead me into a long, and, perhaps, a tedious investigation. I think I may

venture to affirm, that such of your readers as are occupied practically in mechanical pursuits, will derive some information on this important subject from a series of papers on STEEL, communicated by, Mr. Editor,

Your obedient Servant,
AN AMATEUR MECHANIC.

PROPERTIES OF ATMOSPHERIC AIR.

(*Continued from page* 302.)

FROM what has been advanced, it appears that the atmosphere consists chiefly of three distinct elastic fluids united together by chemical affinity—namely, air, vapour, and carbonic acid gas; differing in their proportions at different times and in different places; the average proportion of each is

98.6 air
1.0 carbonic acid
0.4 water

100.0

But besides these bodies, which may be considered as the constituent parts of the atmosphere, the existence of several other bodies has been suspected in it. It is not meant in this place to include among those bodies electric matter, or the substance of clouds and fogs, and those other bodies which are considered as the active agents in the phenomena of meteorology, but merely those foreign bodies which have been occasionally found or suspected in air. Concerning these bodies, however, very little satisfactory is known at present; as we are not in possession of instruments sufficiently delicate to ascertain their presence. We can indeed detect several of them actually mixing with air, but what becomes of them afterwards we are unable to say.

1. Hydrogen gas is said to have been found in air situated near the crater of volcanoes, and it is very possible that it may exist always in a very small proportion in the atmosphere; but this cannot be ascertained till some method of detecting the presence of hydrogen combined with a great proportion of air, be discovered.

2. Carbonated hydrogen gas is often emitted by marshes in considerable quantities during hot weather. But its presence has never been detected in air; so that in all probability it is again decomposed by some unknown process.

3. Oxygen gas is emitted abundantly by plants during the day. There is some reason to conclude that this is in consequence of the property which plants have of absorbing and decomposing carbonic acid gas. Now as this carbonic acid gas is formed at the expense of the oxygen of the atmosphere; as this oxygen is again restored to the air by the decomposition of the acid; and as the nature of atmospheric air remains unaltered; it is clear that there must be an equilibrium between these two processes: that is to say, all the carbonic acid formed by combustion, must be again decomposed, and all the oxygen abstracted must be again restored. The oxygen gas which is thus continually returning to the air, by combining with it, makes its component parts always to continue in the same ratio.

4. The smoke and other bodies which are continually carried into the air by evaporation, &c., are probably soon deposited again, and cannot therefore be considered with propriety as forming parts of the atmosphere. But there is another set of bodies, which are occasionally combined with air, and which, on account of the powerful action which they produce on the human body, have attracted a great deal of attention. These are known by the name of *contagion*.

That there is a difference between the atmosphere in different places, as far as respects its effects upon the human body, has been considered as an established point in all ages. Hence some places have been celebrated as healthy, and others avoided as pernicious, to the human constitution. It is well known that, in pits and mines, the air is often in such a state as to suffocate almost instantaneously those who attempt to breathe it. Some places are frequented by peculiar diseases. It is known that those who are much in the apartments of persons ill of certain maladies, are extremely apt to catch the infection; and in prisons and other places, where crowds of people are confined together, when diseases once commence, they are wont to make dreadful havoc. In all these cases it has been supposed that a certain noxious matter is dissolved by the air, and that it is the action of this matter which produces the mischief.

Thus there are four substances which have the property of destroying contagious matter, and of purifying the air; but acetic acid cannot easily be obtained in sufficient quantity, and in a state of sufficient concentration to be employed with advantage. Nitric acid is attended with inconvenience, because it is almost always contaminated with nitrous gas. Muriatic

acid and oxy-muriatic acid, are not attended with these inconveniences; the last deserves the preference, because it acts with greater energy and rapidity. All that is necessary is, to mix together two parts of salt-water with one part of the black oxide of manganese, to place the mixture in an open vessel in the infected chamber, and to pour upon it two parts of sulphuric acid. The fumes of oxy-muriatic are immediately exhaled, fill the chamber, and destroy the contagion.

HISTORY OF MEDALS.

(Continued from page 301.)

The first silver denarii coined at Rome, are supposed by our author to have been those which are impressed with the Roma; and he inclines to account those the most ancient that have a double female head on the one side, and on the reverse Jupiter in a car, with Victory holding the reins, and the word Roma indented in a rude and singular manner. The double female head seems to denote Rome, in imitation of the Janus then upon the *as*. There are 15 of these in the cabinet of Dr. Hunter; one of the largest weighs 98¼ grains: and the rest, which seem to be of the greatest antiquity, are of various weights betwixt that and 81; the smaller and more modern weigh 58 or 59 grains; but Mr. Pinkerton is of my opinion, that the large ones are of the very first Roman coinage, and struck during that interval of time betwixt the coinage of the first silver denarius and the *as* of two ounces. He takes the indentation of the word Roma, to be a mark of great antiquity; such a mode being scarcely known anywhere else, except in Caulonia, Crotona, and other towns of Italy; all of them allowed to be struck at least 400 B. C. As these coins are not double denarii, they must have been struck prior to the small ones; and Neumann has given an account of one of them recoined by Trajan, in which the indentation of Roma is carefully preserved. The first denarius was in value 10 *ases*, when the *as* weighed three ounces; and allowing 90 grains at a medium for one of these large denarii, the proportion of copper to silver must have been as 1 to 160: but when the *as* fell to one ounce, the proportion was as 1 to 80; when it fell to half-an-ounce, so that 16 *ases* went to the denarius, the proportion was as 1 to 64, at which it remained. Copper with us, in coinage, is to silver as 1 to 40; but in actual value as 1 to 72.

At Rome the denarius was worth 8d.; the quinarius 4d.; and the sestertius, whether silver or brass, 2d. The denarius is the coin from which our penny is derived, and was the chief silver coin in Rome for 600 years. According to Celsus, seven denarii went to the Roman ounce, which in metal did not exceed 430 grains; but as all the denarii hitherto met with, weigh at a medium only 60 grains, this would seem to make the Roman ounce only 420 grains; though perhaps this deficiency may be accounted for from the unavoidable waste of metal even in the best preserved of these coins. According to this proportion, the Roman pound contained 84 denarii; but in tale there was a very considerable excess; for no fewer than 100 denarii went to the Roman pound. The Greek ounce appears to have been considerably larger than that of Rome, containing about 528 grains; yet notwithstanding this apparently great odds, the difference in the coins was so small, that the Greek money went current in Rome, and the Roman in Greece. The denarius at first went for 10 *ases*, and was marked X: it was afterwards raised to 16; which Mr. Pinkerton supposes to have been about 175 B. C. Some are met with bearing the number XVI. nay, with every number up to CCCCLXXVI. These large numbers are supposed to have been mint-marks of some kind or other. After being raised to 16 *ases*, it continued at the same value to the time of Gallienus; so that till that time we are to look upon its constituent parts to be 16 *ases* or assaria, eight dupondii, four brass sestertii, and two silver quinarii. Under the Emperor Severus, however, or his successor Caracalla, denarii were struck of two sizes, one of them a third heavier than the common; which we must of consequence suppose to have borne a third more value. This large piece obtained the name of argentus, and argenteus Philippus, or the "silver Philip;" the name of Philip having become common to almost every coin. The common denarii now began to be termed minuti and argenti, Philippi minutuli, &c. to express their being smaller than the rest. Some have imagined that the large denarii were of the same value with the small, only of worse metal; but Mr. Pinkerton observes, that among the few which have any difference of metal, the smallest are always the worst. The first mention of the minuti is in the time of Alexander Severus, who reduced the price of pork from eight minuti at Rome, to two and to one. The minutus argenteus of that age, was about 10 grains; and,

from the badness of the metal, was not worth above 4d. of our money. Thus the price of meat was by this prince reduced first to 8d. and then to 4d.

According to Zozimus and other writers, the purity of the Roman coin was restored by Aurelian; but Mr. Pinkerton controverts this opinion; thinking it most probable, that he only made the attempt without success; or that his reformation might be entirely confined to gold, in which there is an evident change after the time of this emperor. His successor Tacitus is said to have allowed no brass to be mixed with silver upon any account; yet the few coins of this emperor are very much alloyed. We are certain, however, that the Emperor Dioclesian restored the silver to its ancient purity; the denarii struck in his reign, being very small indeed, but of as fine silver as the most ancient coins of the empire. After Gordian III. the small denarius entirely vanished; while the large one was so much diminished, that it resembled the minutus, or small one of Caracalla, in size. Gallienus introduced the denarii ærei instead of the sestertii. The argenteus, though reduced more than one-third in size, contained six denarii ærei, the old standard of sestertii. According to the writers of this period, and some time afterwards, the denarius or argenteus contained 60 assaria; whence it follows, that each denarius æreus had 10; and from this it probably had its name. The assaria are of the size of the argentei already mentioned; and show the copper to have retained nearly its old proportion of value to the silver—viz. 1 to 60.

A larger silver coin was introduced by Constantine I. who accommodated the new money to the pound of gold in such a manner, that 1000 of the former in tale, were equal to the latter in value; so that this new piece from thence obtained the name of the milliarensis or "thousander." Its weight at a medium is 70 grains, or 70 to the pound of silver: but Mr. Pinkerton is of opinion, that it might have contained 72 grains, of which two have now perished by the softness of the silver; that the pound contained 72; or that two of the number might be allowed for coinage; while the alloy alone would pay for coining gold. The code says, that 60 went to the pound; but the numbers of this are quite corrupt. The milliarensis was worth about a shilling sterling. The argentei or denarii, however, were still the most common currency; and having been originally rated at 100 to the pound of silver in tale, they from thence began to be called centenionales, or "hundreders." Those of Constantine I. and II. Constans, and Constantius, weigh from 50 grains down to 40; those of Julian and Jovian, from 40 to 30; and of the succeeding emperors from that time to Justinian, from 30 to 20. Under Heraclius they ceased entirely; and, from Justinian to their total absolution, had been brought down from 15 to 10 grains. A like decrease of weight took place in the milliarensis; those of Constantine and Constans being above 70 grains in weight; those of Arcadius not above 60; and the milliarensis of Justinian not more than 30 grains; but, from the weight of those in Dr. Hunter's cabinet, Mr. Pinkerton deduces the medium to have been exactly $70\frac{8}{17}$ grains. These coins were also called majorinæ.

CAUSES OF RAIN.

(Continued from page 303.)

THE raining of fishes has been a prodigy also much talked of in France, when the streets of a town at some distance from Paris, after a terrible hurricane in the night, which tore up trees, blew down houses, &c., were in a measure covered with fishes of various sizes. Nobody here made any doubt of their having fallen from the clouds; nor did the absurdity of fish of five or six inches long, being generated in the air, at all startle the people, or shake their belief in the miracle, till they found upon inquiry, that a well stocked fish-pond, which stood on an eminence in the neighbourhood, had been blown dry by the hurricane, and only the great fish left at the bottom of it, all the smaller fish having been tossed into their streets. Upon the whole, all the supposed marvellous rains have been owing to substances naturally produced on the earth, and either never having been in the air at all, or only carried thither by accident. In Silesia, after a great dearth of wheat in that country, there happened a violent storm of wind and rain, and the earth was afterwards covered in many places with small round seeds. The vulgar cried out that Providence had sent them food, and that it had rained millet; but these were, in reality, only the seeds of a species of veronica, which is very common in that country; and whose seeds, being just ripe at that time, the wind had dislodged from their capsules, and scattered about. In our own country we have histories of rains of this marvellous kind, but all fabulous. It was once

said to rain wheat in Wiltshire; and the people were all alarmed at it as a miracle, till Mr. Cole showed them that what they took for wheat, was only the seeds or kernels of the berries of ivy, which, being then fully ripe, the wind had dislodged from the sides of houses and trunks of trees on which the ivy that produced them crept. And we even once had a raining of fishes, near the coast of Kent, in a terrible hurricane with thunder and lightning. The people who saw small sprats strewed about afterwards, would have it that they had fallen from the clouds; but those who considered how far the high winds had been known to carry the sea-water did not wonder that they should be able to carry small fish with it so small a part of the way. In the "Philosophical Transactions" for 1782, we have the following account of a preternatural kind of rain, by Count de Giveni:—"The morning of the 24th instant, there appeared here a most singular phenomenon. Every place exposed to the air was found wet with a coloured cretaceous grey water, which, after evaporating and filtrating away, left every place covered with it to the height of two or three lines; and all the iron-work that was touched by it became rusty. The public, inclined to the marvellous, fancied various causes of this rain, and began to fear for the animals and vegetables. In places where rain-water was used, they abstained from it; some suspecting vitriolic principles to be mixed with it, and others predicting some epidemical disorder. Those who had observed the explosions of Etna twenty days and more before, were inclined to believe it originated from one of them. The shower extended from N. ¼. N. E. to S. ¼. S. W. over the fields about seventy miles in a right line from the vortex of Etna.

"There is nothing new in volcanoes having thrown up sand and also stones, by the violent expansive force generated in them, which sand has been carried by the wind to distant regions." But the colour and subtility of the matter occasioned doubts concerning its origin, which increased from the remarkable circumstance of the water in which it came incorporated; for which reason, some other principle or origin was suspected.

"It became therefore, necessary, by all means, to ascertain the nature of this matter; in order to be convinced of its origin, and all the effects it might produce. This could not be done without a chemical analysis. To do this then with certainty, I endeavoured to collect this rain from places where it was most probable no heterogeneous matter would be mixed with it. I therefore chose the plant called trassica capitata; which, having large and turned up leaves, thus contained enough of this coloured water; many of these I emptied into a vessel, and left the contents to settle till the water became clear. This being separated into another vessel, I tried it with vegetable alkaline liquors and mineral acids, but could observe no decomposition by either. I then evaporated the water, in order to reunite the substances that might be in solution; and touching it again with the aforesaid liquors, it showed a slight effervescence with the acids. When tried with the syrup of violets, this became a pale green; so that I was persuaded it contained a calcareous salt. With the decoction of galls, no precipitation was produced.

"The matter being afterwards dried in the shade, it appeared a very subtile fine earth, of a cretaceous colour, but lurid from having been diluted by the rain. I next thought of calcining it with a slow fire, and it assumed the colour of a brick. A portion of this being put into a crucible, I applied it to a strong heat, by which it lost almost all its acquired colour. Again I exposed a portion of this, for a longer time, to a very violent heat (from which a vitrification might be expected); it remained, however, quite soft, and was easily burned, but it returned to its original dusky colour. From the most accurate observations of the smoke from the three calcinations, I could not discover either smell or colour that indicated any arsenical or sulphureous mixture. Having therefore calcined this matter in three portions, with three different degrees of fire, I presented a good magnet to each; it did not act either on the first or second; a slight attraction was visible in many places on the third. This persuaded me that this earth contains a martial principle in a metallic form, and not in a vitriolic substance. The nature of these substances then being discovered, their volcanic origin appears; for iron, the more it is exposed to calcination, the more it is divided by the loss of its phlogistic principle, which cannot naturally happen but in the great chimney of a volcano. Calcareous salt, being a marine salt, combined with a calcareous substance, by means of violent heat, cannot be otherwise composed than in a volcano." As to their dreadful effects on animals and vegetables, every one knows the advantageous use in medicine, both of one and the other; and this in the same form, as they are thus prepared in the great laboratory of nature.

"Vegetables even in flower, do not appear in the least macerated, which has formerly happened from only showers of sand. How this volcanic production came to be mixed with water may be conceived in various ways. Etna about its middle regions, is generally surrounded with clouds that do not always rise above its summit; which is 2900 paces above the level of the sea. This matter being thrown out and descending upon the clouds below, it may happen to mix and fall with rain in them in the usual way. It may also be conjectured, that the thick smoke which the volcanic matter contained, might, by its rarefaction be carried by the wind over that tract of country; and then cooling so as to condense and become specifically heavier than the air, might descend in that coloured rain. I must however leave to philosophers (to whom the knowledge of natural agents belongs), the examination and explanation of such phenomena, confining myself to observation and chemical experiments."

MISCELLANEA.

Archimedean Screw.—A colossal steamer on the Archimedean-screw principle, called the *Great Northern*, was launched at Belfast last week. In the water she looks like a sailing vessel—she will be able to spread 6400 yards of canvass, and is to be fully rigged as a 50-gun frigate. Burthen 1750 tons; engines nearly 400 horse-power. The engines are to be fitted close abaft the vessel, leaving the midships clear for passengers. The experiments made since the launch prove that the screw is applied on the most approved principle. It is twelve feet diameter, and fourteen feet pitch, but the length is only seven feet; it is to make eighty-eight revolutions per minute; the gearing consists of a cog-wheel, twenty feet diameter, working into a small wheel, of five feet diameter, upon whose axis is the shaft of the screw.

Astonishing Expedition in the Manufacture of a Coat.—On Thursday we were favoured by Messrs. A. and D. Webster of this town, with a beautiful brown dress coat, manufactured by them in an astonishingly short space of time. The appearance of the coat is very beautiful, and fully proves that great expedition may be used in manufacturing clothes under the present system. The wool of which this coat is made was in a raw state, and to sort, after two o'clock on Thursday morning: it passed through the usual process of scouring, dyeing, scrubbing, spinning (on the jenny), weaving (by hand), and milling, and was manufactured into superfine cloth in twelve hours and fifteen minutes. The cloth was then finished, by the patent process, in two hours and fifty-three minutes, by Mr. William Kirk, of Larchfield, and then made into a dress-coat by Messrs. Robinson and Russum, in the short space of three hours and fifty-five minutes. The whole time that elapsed between the coat being in the wool and made up and weaving, was only nineteen hours! In the ordinary way, cloth is often two months in passing through the various processes of manufacturing and finishing.—*Leeds Paper.*

Algiers Wheat.—A very interesting statement is contained in the advices recently received from France relative to a comparatively modern growth of wheat in the departments of Asine and Craonne, and which has been introduced from the African colony, and is therefore termed Algiers corn. This grain appears to have certain valuable properties worth noticing. It is sown from the 1st to the 10th of May; and fit to reap about the same time as the autumn-sown wheat. One hectolitre, or $2\frac{3}{4}$ bushels, is usually sown to the hectare, or 100 acres (this seems a mistake, but it is so stated in the accounts), and the produce thereof is usually 800 sheaves, or twelve hectolitres of corn. The flour made from this grain is of a light yellow colour, and makes savory white bread. The straw is not so useful as that of the ordinary European wheat, but animals prefer it; its peculiar advantages are said to be that it is very easily thrashed, the corn falling out at the first blow of the flail, and that it is a very useful grain upon soils that are very wet during the winter, and therefore most adapted to spring sowing. It also answers very well to sow upon lands where the winter-sown seed has been destroyed.

REVIEW.

Darby's New Map of London. Darton and Clark, Holborn Hill.

THE facility with which any place in the Metropolis may be discovered, by means of an index in the margin corresponding with divisions through the map, renders this the most acceptable guide to London we have ever yet seen. No stranger nor even stated resident in town, should be without it. Its price is exceedingly moderate.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Friday, September 2, Election of Committee. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, Sept. 1, Richard King, Esq., on Arctic Discovery. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, August 29, Hyde Clark, Esq., on Colour. At a quarter-past eight o'clock.

QUERIES.

A description of the Koniaphostic or lime light, and how I can produce it with the least expense; and if any particular apparatus is required, where I can get it, and the price. Perhaps G. Starkey, or any other of your correspondents, will be kind enough to answer this, when it is convenient. J. M. J.

Can you inform me which is the best work yet published to enable a person studying design to acquire a knowledge of light and shade? E. G.

ANSWERS TO QUERIES.

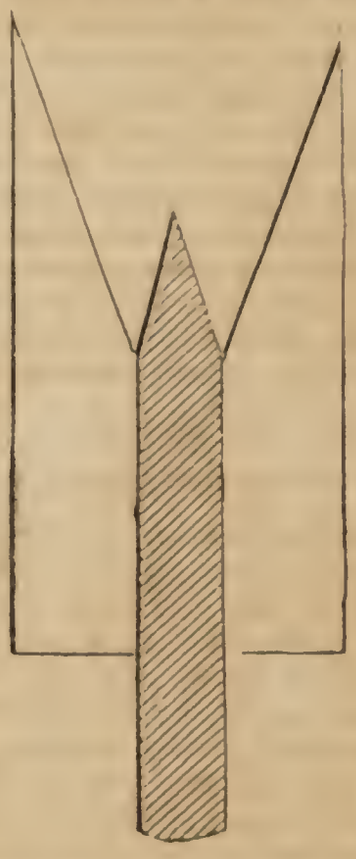
SIR,—I have only lately seen the last two Parts of the PENNY MECHANIC, in which I find several queries, which, to answer satisfactorily, require more space than I apprehend you can conveniently spare in the usual place. I therefore think it better to address several of your correspondents in the present form.

To "W. Botterill's" inquiry, I reply, there are so many varieties of universal chucks, that to give a tolerably clear description of the whole, would require a series of papers extending over many pages. Perhaps the best, in every respect, is the PATENT CONCENTRIC or LEVER CHUCK, invented and constructed by Stiven, of Manchester, a most ingenious and deserving mechanic. This chuck is a very beautiful specimen of mechanical power, effected by simple means; the price, too, is extremely moderate. The *curval* chuck I do not know under that designation, and shall feel obliged if "W. B." will describe its mode of acting, and the purposes to which it is applied.

Of one very important fact, which refers to all chucks, "W. B." appears to be ignorant—viz. that it is absolutely indispensable the chuck be *screwed and turned on the mandrel* with which it is intended to work; since it is manifestly impossible, whatever care be taken, to insure truth of movement by any other means. I regret I cannot answer "W. B.'s" inquiry respecting the eccentric chuck, within the limits of a few lines; but if he be not in haste, he will assuredly find a full description of this and every other chuck for ornamental turning, together with other apparatus connected with the lathe, in a work which has long engaged my attention, and is now nearly ready for the press.

"E. L." will derive much information by carefully studying the principle of Count Suardi's geometric pen. The treatise on diagonal motion, in "Rees' Cyclopædia," is well worth perusal, if he wish to master the difficult but interesting mechanism by which medallic engraving is effected. AMATEUR MECHANIC.

SIR,—In answer to "Amateur Mechanic's" query in No. 96, it gives me great pleasure to inform him, that the tool called a bell or centre punch, will insure a small hole being formed in the centre of a metal pin or such like article, for the purpose of chucking it truly in the lathe. It consists of a solid cylinder of gun-metal or steel, with a hole drilled through its axis, in which a



pointed steel punch fits accurately for about one-half of its length; the lower half of the cylinder is turned on the inside to a conical figure, which, if placed over the pin, and the punch be struck, will cause a hole to be produced sufficiently near the centre for all practical purposes, although, perhaps, not truly correct. As I am of opinion that one line of drawing is worth a dozen lines of description, I enclose a sketch, which will, I trust, be readily comprehended;

And remain, Sir,

Your obedient Servant,

POLYTECHINCUS.

TO CORRESPONDENTS.

Various correspondents will be replied to in our next.

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

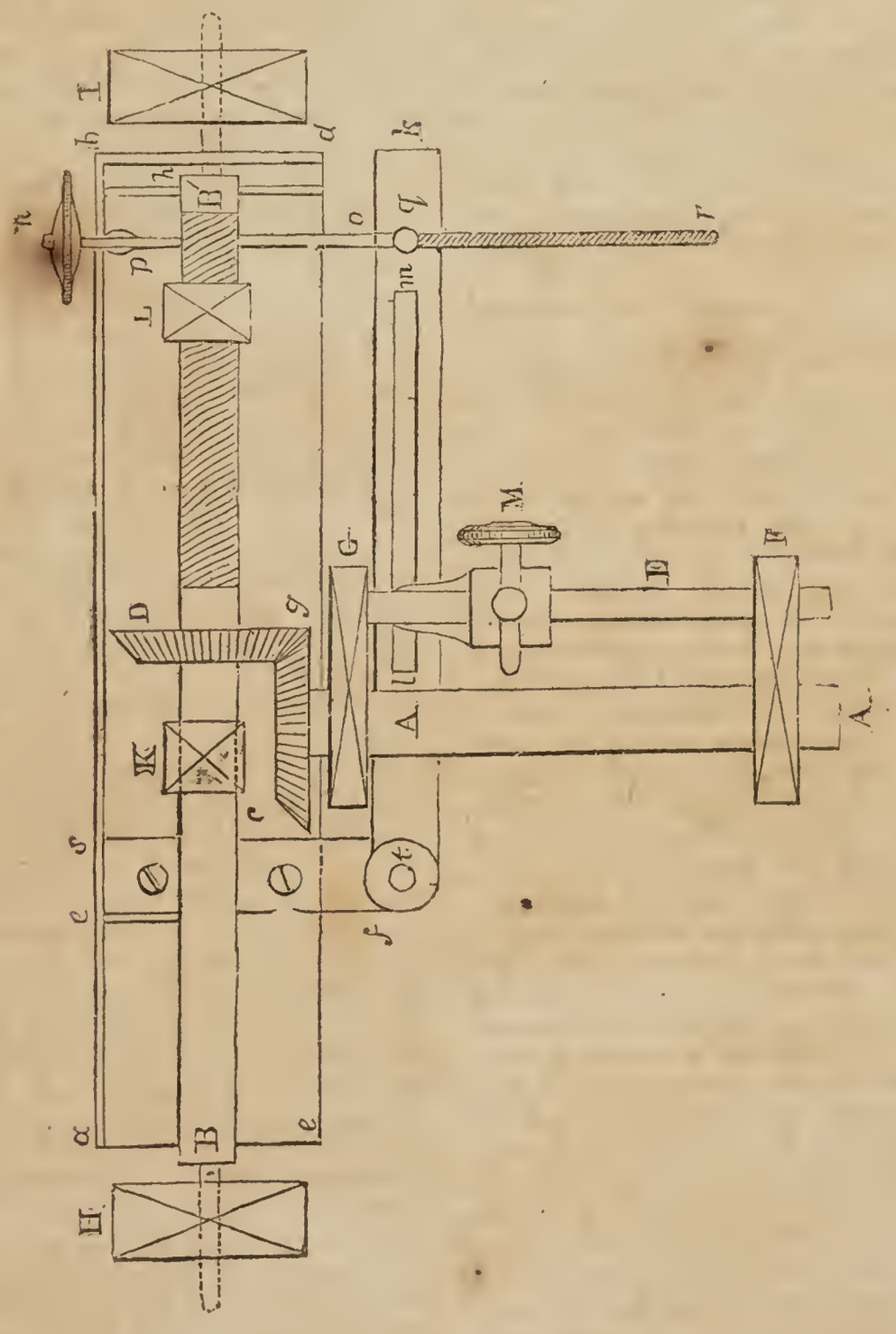
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 99, THIRD SERIES. | SATURDAY, SEPT. 3, 1842. | No. 347, OLD SERIES.

ON CUTTING SCREWS IN THE LATHE.



Vol. VIII.—No. 40.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ON CUTTING SCREWS IN THE LATHE.

No. VII.

(See Engraving, front page.)

31. In the first of this series of papers, (Part VI.) we have explained, that an inclined plane may be applied to give the required motion to the chasing tool, in cutting screws of ordinary dimensions; and also that the inclined plane might receive its movement, either by a rack and pinion, or by a screw placed at right-angles to the cylinder on which the spiral thread is to be cut; we referred to Ferdinand Berthoud's description of a fusee-engine,* as illustrative of the first mentioned of these two methods. We now propose giving an example of the second, because the principle is extremely ingenious, and appears to deserve the attention and study of the practical mechanic; moreover, it is little known, and has never, we understand, been introduced in any of the many beautiful screwing machines manufactured in this country.

Fig. 19, A A′, is a cylinder on which the helical thread of a screw is to be cut; it is supported by the two upright pieces, or puppets, F and G; at the extremity, A, is fixed a bevelled toothed wheel, C. The motive power used to give the cylinder the necessary rotation, is applied at the extremity, A′; the axis, B B′, is perpendicular to the cylinder, A A′, and is supported by the two puppets, H and I. This axis carries a bevelled toothed wheel, D, which takes into, and works with, the wheel, C; the portion, *g h*, of the axis, B B′, has a screw very accurately cut on its surface. E is a bar of metal, on which a sliding piece traverses, carrying the cutting tool, M; this bar is either of a triangular or quadrangular form—but the former is decidedly preferable—and is supported by the two puppets, F and G. *a b c d*, is a large and deep mortice formed in the plane, on which the supporting pieces or puppets, F, G, H, and I, are placed. *e f b d*, is a bar whose thickness is equal to the depth of the mortice, *a b c d*; it moves within the mortice, and has a free sliding motion throughout its entire length. The two upright bearers or puppets, K and L, are placed upon the bar, *e f b d*; the former of these terminates in a cylinder which has a circular aperture, through which the axis, B B, passes; and the other—namely, L, terminates in the nut of the screw, *g h*. At the extremity, *e f*, of the bar, *e f b d*, is fixed the bar, *e s i*; the bar, *i k*, has a motion of rotation about the point, *i*, as a centre; it has a longitudinal opening or groove, *l m*, into which passes a small cylinder attached to the sliding piece, M. *p* and *q* are balls which form the upper terminations of two small cylinders, which project one of them from the bar, *e f b d*, the other from the bar, *i k*; and they have each a free motion of rotation upon their respective axes. The portion, *n o*, of the arm or rod, *n r*, is cylindrical, and passes through the circular aperture of the ball, *p*: it is at liberty to turn freely, but has no sliding motion; the other portion, *o r*, of the same rod, *n r*, has a screw already cut on it, and it passes into its nut, which is tapped within the ball, *q*.

This description being understood, it is obvious that, if the cylinder, A A, be made to revolve, the circular motion so produced, will be transmitted to the axis, B B; the bar, *e f b d*, will be accordingly set in motion, and will carry with it the bar or arm, *i k*. The angle of inclination of this latter may be varied at pleasure, by means of the adjustment afforded by the rod, *n r*; it will thus perform the office of an inclined plane, and will effect the guidance of the cutting tool, M, with the velocity that may be required.

35. We need scarcely observe that the arrangement and combination of mechanism in this screw cutting apparatus, is too complicated for general use; the principle is capable of being worked out in a very simple way, and, in consequence, an improved mode of action obtained. We introduce it to the readers of the PENNY MECHANIC, as an elaborately wrought specimen of machinery, in which the inclined plane is made to produce the helical thread of a screw on any revolving cylinder; and, as already observed, we deem it worthy of the patient and attentive consideration of every student of mechanics. Such of our readers as are, or may be, disposed to pursue the inquiry, we refer to Thiout, *Traité d' Horlogerie*; and Ferdinand Berthoud, *Essai sur l Horlogerie*: in both works they will find much curious information respecting the inclined plane, as a guide to the cutting tool; we also strongly recommend the various articles, CLOCK, HOROLOGY, and LATHE, in "Rees' Cyclopædia," 4to.

36. We have now, to the best of our ability, and, as we trust, faithfully described and illustrated the more important mechanical contrivances which relate to screw-cutting by means of a lathe. Here

* In "Rees' Cyclopædia," *Horology*, pl. xxxvii. and xxxviii. the reader will find engravings of several engines, in which the inclined plane acts as a guide to the cutting tool.

it was our intention to have concluded this section of the inquiry, and to have proceeded to other modes of making a screw—namely, with the aid of a tool called a STOCK and DIES, or a SCREWING STOCK and DIES; but we find among our papers, memoranda of a very ingenious plan, which may be said to partake partly of rotary motion, and partly of the fixed action of dies. We therefore introduce it in this place, the rather as a *perfect screw*, or indeed, one approaching perfection—that is, a screw true in relation to the proportions and regular inclination of its thread, is one of, if not the most important matter in many branches of mechanical industry.

37. Mr. Allan, an astronomical and mathematical instrument-maker, found—as indeed have most mechanics—great difficulty in cutting screws in the common dies. He could not free them from two capital faults: the one that the threads of the screws were not of a truly regular inclination; and the other, that in consequence of the force required to cut the thread of the screw, either in a pair of dies, or in a screw-plate, they were unavoidably bent and twisted. This is so serious an evil, that not only does it cause the screw, for any common purpose, to work out of truth in its bearings, but renders it utterly unfit for any nice or delicate operation, which requires a screw accurate in the highest degree.

But the greatest and most important of all purposes to which a screw can be applied, is the mathematical dividing engine; and that requires only a short screw, such as the tool we shall describe in our next can readily make. The apparatus constructed by Mr. Ramsden, to cut the screw of his dividing engine, cost an enormous sum of money, but is incapable, nevertheless, of cutting any other than a screw of very limited length. Whereas, Mr. Allan's method is alike simple in its construction and easily comprehended; so that any tolerable mechanic, accustomed to work in metal, can make it, and at the cost of the common stock and dies. It must also be remarked, that not only does this tool make a screw true to itself and to its bearings, but it likewise affords an opportunity of cutting a perfect screw of considerable length; so that every thread shall be duly proportioned and in its proper place. This is effected by dividing the proposed screw into portions, and beginning to cut it at different parts; by which means, and reversing the screw, any error is immediately detected and removed.

LITHOGRAPHIC PRINTING.

(Continued from page 293.)

WE will now enumerate some other difficulties which are not referrible to the above general principle.

If the pressure of the scraper be too weak, the ink will not be given off to the paper in the impression, although the drawing has been properly charged with it. Defects will also appear from the scraper being notched, or not correctly adjusted, or from any unevenness in the leather or paper. Inequalities in the roller will cause the drawing to receive the ink unequally, and, if the roller or its leather be too hard, it will not ink the drawing clearly.

After printing a considerable number of impressions, it sometimes happens that the drawing takes the ink in dark spots in different parts. This arises from the printing-ink becoming too strongly united with the chalk or ink of the drawing; and if the printing be continued, the drawing will be spoiled. A little consideration will show us the reason of this accident. The printing-ink readily unites with the drawing, and, being of a thinner consistency, it will, by repeated applications, accumulate on the lines of the drawing, soften them, and make them spread. In this case it is necessary to stop the printing for a day or two, for the drawing to recover its proper degree of hardness. If the drawing should run smutty from any of the causes before enumerated, the following mixture will clean it:—

Take equal parts of water, spirits of turpentine, and oil of olives, and shake them well together in a glass phial until the mixture froths; wet the stone and throw this froth upon it, and rub it gently with a soft sponge. The printing-ink will be dissolved, and the whole drawing also will disappear; though, on a close examination, it can be distinguished in faint white lines: on rolling it again with printing-ink, the drawing will gradually reappear as clear as at first.

Accidents sometimes occur in the printing, from the qualities of the paper; if the paper has been made from rags which have been bleached with oxymuriatic acid, the drawing will be incurably spoiled after thirty impressions. Chinese paper has sometimes a strong taste of alum; this is so fatal as occasionally to spoil the drawing after the first impression. When the stone is to be laid by after printing, in order that it may be used at a future period, the drawing must be rolled in with a preserving ink, called by Sene-

felder, actyfoebe; as the printing-inks would, when dry, become so hard that the drawing would not take fresh printing-ink freely. The following is the composition of the preserving ink :—

Thick varnish of linseed oil	2	parts
Tallow	4	do.
Venetian turpentine	1	part
Wax	1	do.

These must be melted together, then four parts of lamp-black very carefully and gradually mixed with it; and it must be preserved for use in a close tin box. Very good effects are produced in lithographic prints, by printing from two or more stones, with differently coloured inks. This is managed by preparing a composition of

Wax	2	parts
Soap	1	part
A little vermilion.		

Melt them in a saucepan, and cast them into sticks. This must be rubbed up, with a little water, to the thickness of cream, and applied to the surface of a polished stone. An impression is taken in the common way from a drawing, and applied to a stone prepared in this manner, and passed through the press; taking care to make, by means of this impression, two points in the margin corresponding on each of the stones. The artist having thus on the second stone an impression from the first drawing to guide him, scrapes away the parts he wishes to remain white in the finished impression. The stone must now be etched with acid stronger than the common etching-water, having one part of acid to twenty of water. The whole is then washed off with turpentine.

This plan has been very much followed at Munich. It is generally used to print a middle tint from the second stone. The black impression being given from the first stone, a flat transparent brownish tint is given from the second, and the white lights are where the paper is left untouched; the dots are necessary to regulate the placing of the paper on the corresponding parts of the two stones.

The coloured inks for the tints are differently made according to the tint required, but the varnishes alone make very good light browns.

The paper for lithographic printing should not be so damp as for copper-plate printing.

(To be continued.)

CONSUMING SMOKE IN FURNACES.

The annoyance which the vast increase of steam-engine furnaces has caused, seems to have thoroughly excited the attention of inventors to provide a remedy. Probably, in no place is the inconvenience more felt than on the river Thames, where the chimneys of the vast numbers of steam-vessels completely blacken the air, and send forth volumes of smoke, which frequently cause the act of crossing over London Bridge to be absolutely a "deed of darkness." There is no doubt that the perfect combustion of smoke would cause a vast saving in the expense of fuel; for it is ascertained by both synthesis and analysis, that about thirty-eight per cent. of the total heat which can be obtained from coal is due to the gaseous matter that it contains (varying of course with the quality of the coal), of which a large proportion generally escapes in the form of smoke wholly unconsumed. It is singular how well the results obtained by various inventors of new methods of burning smoke agree with this calculation; for in no furnaces do the whole of these gases escape unconsumed: and consequently we find that the saving by several of the best modes of burning smoke varies from ten to twenty-five per cent., according to the perfection or imperfection of the furnace, previously to the application of the smoke-burning apparatus. All these inventions are simply modifications of two distinct principles—the one consisting in bringing atmospheric air in contact with the flame; the other owing its efficacy to the regular distillation of the gases, by slowly coking the coal in the fore part of the furnace. On one or other of these two principles, all the inventions for consuming smoke are based, however they may appear to differ in their general character; and the only essential difference which exists is, that some heat the air before they bring it into the furnace, and some allow the cold air to enter. The Baron von Rathen's patent is for double or hollow furnace bars, fitted into bearers, which form steps rising one above another, and forming two sides of a triangle. These bars allow a large quantity of air to pass through, which is heated in its passage, and inflames the gases. The saving of fuel is stated to be considerable. Mr. Godson's patent is for feeding the furnace by means of a box placed below the bars; which box, being charged with coal, by turning a winch the fuel is constantly delivered into the body of the fire ready coked, and the fire always kept at the

same height. The air is also heated by passing through holes in the box. The saving of fuel is stated to be about twenty per cent. Mr. S. Hall's apparatus consists of iron pipes, passing from the back to the front of the furnace, by which heated fresh air is brought to the front of the furnace, and mixes with the gases as they distil. The saving here, also, is stated to be very considerable. Mr. Williams' patent is for cold air delivered in jets at the back of the bridge, by which the gases are inflamed immediately they pass the bridge, and the flame extends to a considerable distance into the flues. Four or five or more patents have been taken out (but are now expired) for hollow or split bridges, by which hot air is admitted to the gases as they pass over the bridge. Mr. Cheetham's patent, and also Mr. Neville's patent, are both for the use of fans, differently applied, by which more air is drawn through the furnaces; and Mr. Ivison's patent accomplishes the same object by injecting steam into the furnace through a small tube—the air which is thus drawn into the furnace, being heated in iron pipes. Chappe's patent is for using a small jet of boiling water exactly in the same way as the last-described plan. Mr. Chanter's patent is for coking the coal at the front of the furnace, and also bringing heated air to the gases near the bridge. Mr. Drew's patent is for two sets of bars; and Mr. Kurtz's patent is for three sets of bars. In both these plans the coal is coked before it is burnt. Mr. Thomas Hall uses a double furnace, or rather divides the furnace lengthwise, and charges each alternately with coal, by which the smoke from the fresh coal passes over the incandescent fuel, and receives an additional supply of oxygen in its passage. Mr. Rodda heats the smoke after it passes the bridge, and mixes it with fresh air, and then again passes it through the fire. Besides these, there are many older patents long since expired; but all these inventions are stated to save, and no doubt really do save, considerable quantities of fuel. There are, however, some important considerations to those who employ them connected with some of these inventions; namely, the effect produced upon the boilers, as well by the increased heat as by the particular mode of introducing the air. There is also much difference in the necessary attendance which the furnaces require; and while all these inventions will accomplish the objects proposed, of consuming the smoke and economising the fuel, it behoves those who wish to employ them, carefully to scrutinize their respective merits; as it does not fall within our province to decide upon them. It is quite certain, however, that methods can be employed of consuming smoke with great economy of fuel, and without any destructive effects upon the boiler; and that great public good would result from the general adoption of some of these inventions.

HISTORY OF MEDALS.

(Continued from page 309.)

THE smaller silver coins of Rome were, 1, the quinarius, at first called victoriatus, from the image of Victory on its reverse; and which it continued to bear from first to last. Its original value was five *ases*, but it was afterwards raised to eight, when the value of the denarius increased to sixteen. According to Pliny, it was first coined in consequence of the lex Clodia, about the 525th year of Rome. Some are of opinion, that it was called κερατιον under the Constantinopolitan empire, because it was worth a κερατιον of gold, 144 of which went to the ounce: but this is denied by Mr. Pinkerton, because, at the time that the word κερατιον first appears in history, the denarius did not weigh above thirty grains; and of consequence, as twenty-five must have gone to the gold solidus, of which there were six in the ounce, 130 denarii must have gone to the ounce of gold. He is therefore of opinion, that the word κερατιον, was only another name for the denarius when much reduced in size; probably owing to the great scarcity of silver in Constantinople, though in the same city there was plenty of gold; and of consequence, the gold solidus was never diminished. "For Montesquieu (says our author) has well observed, that gold must be common where silver is rare. Hence gold was the common regulation of accounts in the Eastern empire." The δικερατιον met with in ancient authors, according to Mr. Pinkerton, was merely an improper name for the milliarensis; when, on account of the scarcity of silver, the denarius was reduced, and no milliarenses coined: so that the current milliarensis of former reigns happened to be double to the denarius or centenionalis. The quinarius diminishes in size along with the other coins; those of Augustus weighing thirty grains, of Severus twenty-five, of Constantine I. twenty, of Justinian twelve, and of Heraclius only five. A new silver coinage seems to have taken place after the days of this emperor; as the little we then meet with, which in the best cabinets

scarcely exceeds a dozen of coins, consists entirely of large unshapely pieces of coarse metal.

2. The consular denarius had also four silver sestertii, till the *as* fell to half-an-ounce, when it was thought proper to coin the sestertius in brass, as it continued to be ever afterwards. "The very last silver sestertius (says Mr. Pinkerton) which appears, is one with a head of Mercury, and H. S.; on the reverse a caduceus P. SEPVLLIVS; who appears to be the P. SEPVLLIVS MACER of the denarii of Julius Cæsar. If so (as is most probable) the sestertius was coined in silver down to Augustus; and it is of course not to be expected that any of brass can appear till Augustus, under whom they are actually quite common. I have indeed seen no coin which could be a consular brass sestertius: and though we have certainly brass dupondii of Cæsar, yet it is reasonable to infer, that the brass sestertius was first coined by Augustus. Not one silver sestertius appears during the whole imperial period, yet we know that the sestertius was the most common of all silver coins. The consular sestertii of silver, marked H. S. are not uncommon, nor the quinarii; but the latter are very scarce of all the emperors, if we except one instance, the ASIA RECEPTA of Augustus.

"The Roman gold coinage was still later than that of silver. Pliny tells us, that 'gold was coined sixty-two years after silver; and the scruple went for sixty sesterces. It was afterwards thought proper to coin forty pieces out of the pound of gold. And our princes have by degrees diminished their weight to forty-five in the pound.'" This account is confirmed by the pieces which still remain; for we have that very coin weighing a scruple, which went for twenty sesterces. On one side is the head of Mars, and on the other an eagle; and it is marked XX. We have another coin of the same kind, but double, marked XXXX.; and its triple marked ψX. or sixty; the ψ being the old numeral character for fifty. Mr. Pinkerton, the discoverer of this, treats other medallists with great asperity. Savot and Hardouin are mentioned by name; the latter (he says) is "ignorant of common sense;" and neither he nor Savot could explain it but by reading backward; putting the ψ for the Roman V., and thus making it XV. Other readings have been given by various medallists, but none have hit upon the true one excepting our author, though the coin itself led to it; being just three times the weight of that marked XX. We have likewise half the largest coin, which is marked XXX., and weighs twenty-six grains; the smallest is only seventeen and a half; the XXXX. weighs thirty-four; and the LX. or drachma, fifty-three. There is also the didrachm of this coinage, of 106 grains.

The aurei, or Roman gold coins, were at first forty-eight in the pound; but they were afterwards diminished in number to forty, owing to an augmentation in the weight of each coin. In the time of Sylla, the aurens weighed no less than from 164 to 168 grains, and there were only thirty in the pound; but such confusion in the coinage was introduced by that conqueror, that no person could know exactly what he was worth. Till this time the aureus seems to have continued of the value of thirty silver denarii, about one pound sterling; for about that time it was enlarged a whole third, that it might still be equivalent to the full number of denarii. But after Sylla had taken Athens, and the arts and manners of Greece became objects of imitation to the Romans, the aureus fell to forty in the pound, probably when Sylla had abdicated his dictatorship. Thus, being reduced near to the scale of the Greek χρυσος, it passed for twenty denarii, as the latter did for as many drachmas, being in currency 13s. 4d. sterling. "This (says Mr. Pinkerton) is the more probable, because we know from Suetonius, that the great Cæsar brought from Gaul so much gold, that it sold for nine times its weight of silver: but the Gallic gold was of a very base sort."

In the time of Claudius, the aureus was valued at 100 sesterii, or twenty-five silver denarii, at which it continued till the time of Heliogabalus, when it fell to about ninety-two grains at a medium, or rose in number to fifty-five in the pound. In the reign of Philip, during which the city completed its thousandth year, the aureus was coined of two or three sizes. These are impressed with a head of Rome on one side, and various figures on the other; but the workmanship is so rude, that they are supposed to have been struck in some of the more uncivilized provinces of the empire. The practice of having different gold coins, however, continued under Valerian, Gallienus, and his successors. In the time of Gallienus, they were of thirty, sixty-five, and from eighty-six to ninety-three grains; the double aurei being from 172 to 183¼ grains; but the aureus properly so called was from eighty-six to ninety-three; those of thirty and thirty-two being the trientes aurei of the Historiæ Augustæ Scriptores; while the larger, from sixty-two to sixty-five, are

to be accounted double trientes, and were perhaps called minuti aurei. The value of these different sizes of aurei is not known.

(To be continued.)

MISCELLANEA.

Cast-iron Buildings.—Buildings of cast iron are daily increasing at a prodigious rate in England, and it appears that houses are about to be constructed of this material. It is proposed that the walls shall be hollow, so that the whole house shall be heated by a single stove in the kitchen. A three-story house, containing ten or twelve rooms, will only cost about 1,100*l.*, and it may be taken to pieces and removed to another place at the expense of about 25*l.* It is understood that a large number are about being manufactured, to be sent to Hamburgh for those persons who have had their habitations burnt.—*Morning Paper.*

Unusual Occurrence.—There are at the present moment in the Colburg Dock at Liverpool, four of the largest steam-ships in this or any other country—the Great Western, 1,400 tons; the Acadia and Columbia, 1,200 tons each; and the new steamer Hindostan, recently launched at the above port, and burden 2,017 tons; making altogether a burden of 5,817 tons, and in value estimated at upwards of 200,000*l.*

The mortality from cholera, diarrhœa, and dysentery in London, for the three weeks ending August 6, amounted to 109 deaths; for the previous weeks, ending July 16, forty; making an increase of sixty-nine deaths in the course of the last three weeks—a consequence of the rash indulgence resulting from the plenty and cheapness of fruit. Children and aged persons have been the greatest sufferers.

Public Libraries.—There are, in the United Kingdom, 112 public libraries, or collections of books and records.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, September 7, Quarterly Meeting. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, Sept. 8, James Bennett, Esq., on his Method of Teaching Sight and Part Singing. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Mr. Murrill, on the Present State and Prospects of China. At a quarter-past eight o'clock.

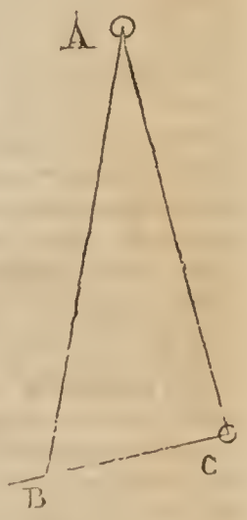
QUERIES.

The author of a series of papers on "Screw-cutting in the Lathe," proposes to continue the inquiry, by describing other modes for cutting a screw—such as the *stock and dies*. He solicits communications from individuals who may possess information in reference either to the form of the stock, the mode of imparting a sliding movement to one or both dies, the best shape for the cutting parts of the dies; as also respecting screw-taps, the best form, the shape of the groove or casing, and any other matter connected with the subject, likely to prove beneficial to men who follow mechanical pursuits as a means of obtaining bread. A. M.

There is a description of lathe, used by pianoforte makers, which is so arranged, that the tool, when required, produces a hexagon, sexagon, or, indeed, any other figure of an even number of sides, instead of a cylinder; a description of this machine will essentially oblige A. M.

If "S. H. J." has not sold his electrical machine, and will furnish me with particulars, I will see whether it will suit me; or has any other correspondent one at a moderate price to dispose of? J. Sinkins.

1. How are watch-faces enamelled? 2. A description of the apparatus used by mathematical instrument makers, to divide and mark the degrees in a circle? 3. How to find the distance of an object by trigonometry? Suppose A is the object, and the angle, A C B, is 90°, A B C 80°, and the distance from B to C, 2 chains, 20 links; required the distance of the object from B. 4. How to test silver? 5. How to make a planisphere? E. L.



ANSWERS TO QUERIES.

"E. L." I regret that, owing to a long and severe fit of illness, I cannot spare time to make copies of minute and complex mechanical drawings, requisite to illustrate the apparatus for copying or engraving medals. This is a subject which has occupied the attention of some of the most scientific minds of the present century. Asa Spencer, an American, introduced a geometric lathe, and Mr. Bates, the eminent and well-known optician of the Poultry, invented a machine for medallic engraving, for which he obtained letters patent in 1832 or 1833: about the same time, Mr. Frowde, a civil engineer, invented a similar machine for the same purpose; the principle, in both, is, I believe, identical, although the details

are entirely different. However, for some reasons, which have never been explained, medallic engraving by machinery has not been rendered practically useful; this is the more extraordinary, as the results are, in every respect, satisfactory, and the expense so trivial as scarcely to be worthy of consideration; the charge for engraving a medal—say two inches diameter—by Mr. Bates' machine, compared with the price asked by an engraver, was as 1 to 40; and if the number required were large, the difference was still greater, 1 to 80—that is, in the first case, *one* to *forty* guineas, and, in the second, *ten shillings* to *forty pounds*; and this rate Mr. Bates deemed sufficiently remunerative. With respect to a geometric chuck, as it is called, I can only refer "E. L." to a diminutive publication entitled, "A Brief Account of Ibbetson's Geometric Chuck," which he can, doubtless, procure of Mr. Weale, Architectural Library, 59, High Holborn—that is, provided he thinks an octavo pamphlet of forty-five pages worth *five shillings!* Had this tract of Mr. Ibbetson's presented any facts of real utility to the mechanic, I should certainly have recommended "E. L." to make the purchase; but as the only important question, or, at least, the only one interesting to the mechanic—viz. the construction of this chuck, denominated geometric, is avoided, I feel justified in giving a caution on this head. Again, instead of instructing us how or in what manner the chuck works, Mr. Ibbetson informs his readers, that he has empowered Messrs. Holtzapffel to make and vend the chuck. All very reasonable and proper, were the price at all commensurate with the powers of the apparatus, which, in my opinion, it is not, judging from the published specimens. But Mr. Ibbetson professes to entertain a sincere love for the art of turning, and offers to answer the inquiries of any amateur; at the same time forgetting, that the very men who would be benefitted by his invention, are precluded, by the conditions he thinks proper to impose, from possessing it. Now if Mr. Ibbetson had claimed the monopoly which the law affords inventive genius, the affair would have assumed a different complexion, and the industrious, but poor, mechanic might have looked forward to the period when the exclusive privilege would have expired, and the machine become public property. I cannot but regret, that an independent gentleman should have, in an evil hour, allowed himself to be seduced into an anomalous companionship with parties who obviously, but very naturally, think more of their own advantage, than the interests of a class whose claims I ever have, and ever shall, advocate—the working mechanics.

"Mechanic" will find that spirits of turpentine applied to the edge of a common drill, renders the operation of boring holes in glass, easy, and reduces it to a matter of certainty.

"J. W." will find a tabular view of the expansion of metals in all the encyclopædiac publications of any character—such as the "Britannica," or Dr. Rees', and, if I am not mistaken, in Dr. Ure's excellent and most accurate "Dictionary of Chemistry;" also in Dr. Thomson's "System of Inorganic Chemistry." The article *Horology* in "Rees' Cyclopædia," is, I believe, the best, in every sense, that has yet appeared in the English language.

"A. M." begs to inform "G. Starkey" that, in consequence of his communication in PENNY MECHANIC, No. 85, he addressed a letter to him, and to his former place of abode. That letter has been returned to "A. M." through the dead-letter office, with the usual memorandum on the envelope. "A. M." thinks the apparatus of M. Grandjean, described by him in the above-mentioned Number of the PENNY MECHANIC, will answer the object "G. Starkey" has in view. Some slight modifications may be necessary, in order to obtain a particular form of spiral; but they are obvious to any one accustomed to the use of a lathe. If the work referred to by "G. S." be "Humelin-Bergeron's Manuel des Tourneurs," in 2 vols., 4to., with an atlas of plates, it can easily be procured through the agency of Mons. Balliere, foreign bookseller, Regent Street, who supplies works printed on the Continent, at the rate of one shilling for the franc. The work in question is published at sixty francs in Paris; consequently it will cost "G. S." 3*l.*, through the channel pointed out. It is by no means a useful book to a practical man; on the contrary, the matter of any value might be compressed in an ordinary *six* or *seven* shillings octavo volume. Any information "G. S." may require, "A. M." will be happy to supply, if he will communicate with him through the Post Office.

"T. P." If the presumed improvement in the steam-engine can be brought to realize anything like "T. P.'s" expectations, it is, doubtless, a very valuable and important discovery; and if "T. P." will intrust his plan to me, in strict confidence, I shall be happy to give him my opinion thereon. Should the improvement appear feasible, I will make a suitable arrangement, and undertake to have the process fairly tested. The Editor of the PENNY MECHANIC will address any letter "T. P." may write to

AN AMATEUR MECHANIC.

TO CORRESPONDENTS.

Wm. Gore Reed.—*We have no country agents for the sale of the* MECHANIC; *but it can be obtained of any bookseller, by being ordered. Our correspondent can also obtain the volumes from the commencement, in the same way, which will save carriage.*

J. K. O. *wants to know of a method by which brass articles can be coated with silver, besides being plated. Perhaps some of our enlightened correspondents can answer this; for we confess that the question is too puzzling for us to understand.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. **100**, THIRD SERIES. | SATURDAY, SEPT. 10, 1842. | No. 348, OLD SERIES.

ON CUTTING SCREWS IN THE LATHE.

Fig. 24. Fig. 25. Fig. 23.

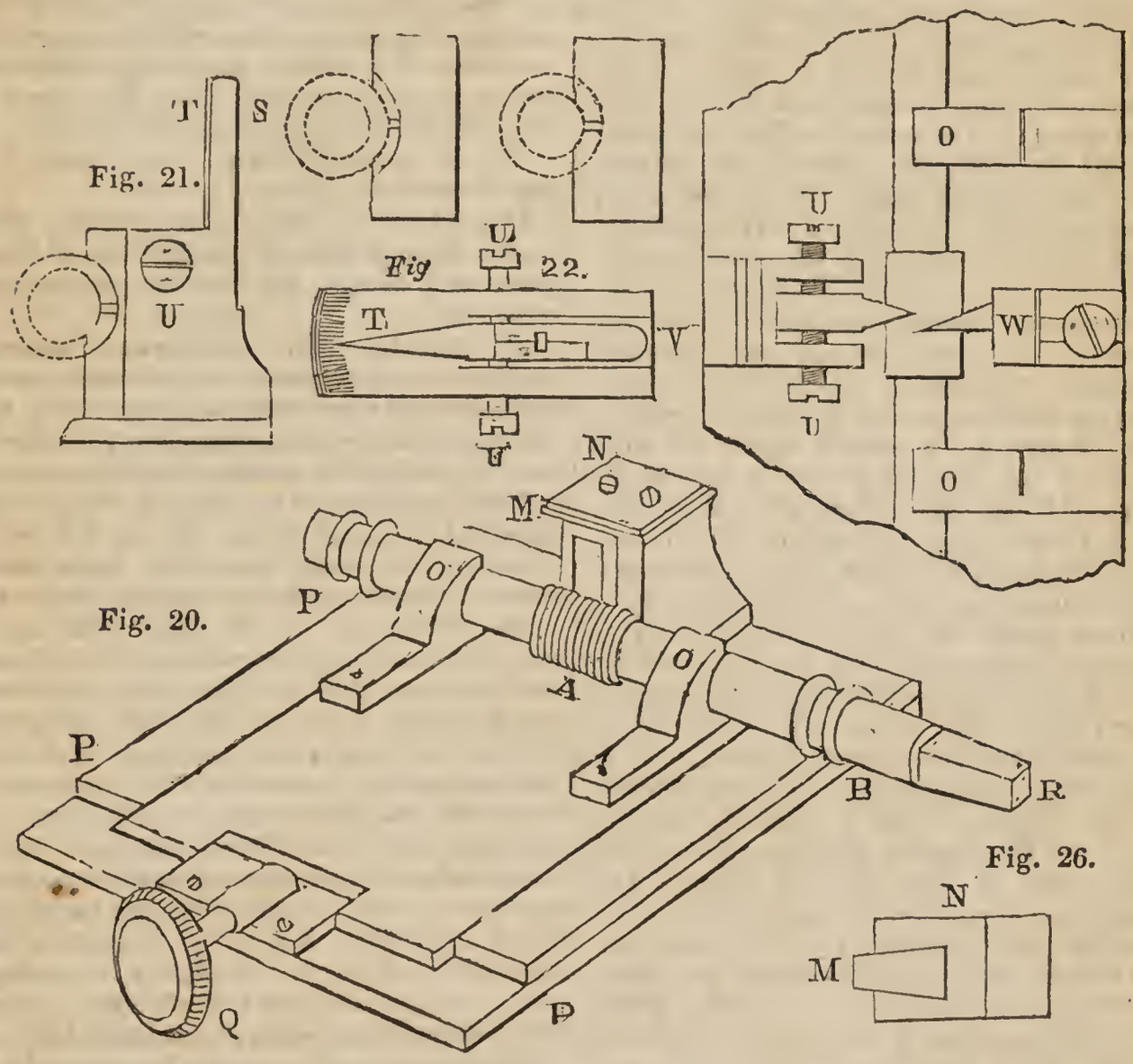


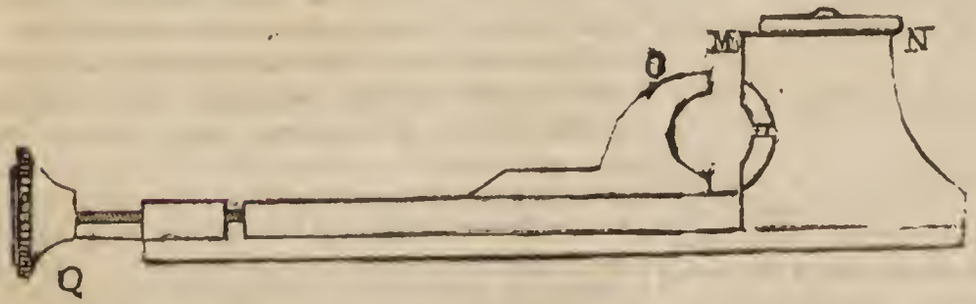
Fig. 21.

Fig. 22.

Fig. 20.

Fig. 26.

Fig. 27.



Vol. VIII.—No. 41] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ON CUTTING SCREWS IN THE LATHE.

No. VIII.

(See Engraving, front page.)

38. Fig. 20 is a perspective view of the tool or frame for cutting screws; N, the stock which holds the die, M; O O, two chaps, or half-holes, which support on one side the cylinder on which the screw is to be cut; these are attached to a plate which slides between the dovetails, P P P P. Q is an adjusting screw which forces the cylinder against the cutter or die.

The cutters and dies are cut or tapped in their places, and consequently are true to the chaps also. The original screw or tap, being made similar in shape to the screw, A, which is shown as being cut in the chaps, O O; a small winch or handle is put on the square end of it, R, to turn it round in the chaps. It is absolutely necessary that these chaps, O O, be apart,* full twice the length of the screw intended to be cut. In order to generate original screws perfectly true, and with any number of threads to the inch, whether right or left-handed, the stock and cutter shown edgewise in fig. 21, and in front in fig. 22, are to be affixed upon the solid basis of the tool, as shown in part of the plan of it, fig. 23. The back of the stock, S, is formed into the segment of a circle, and the top of the cutter, T, into an index. The cutter has only a single, solid, sharp thread, made in the centre of it, with a gap or notch across it, as in ordinary dies; and it can be moved in either direction to the right or left, on its edge below, V, as a centre; this cutter must fit true, and, in like manner, the stock must also fit close to the cutter, to keep it perfectly steady; U U are two screws to adjust and secure the cutter at any required angle. The hollow of the cutter should rather be elliptical than circular; for it is important to insure fitting the cylinder at the greatest angle, at which it may be used. When one turn has been given to the cylinder, a tooth, W, is fitted into the cut in it, and screwed fast to the sliding plate; this tooth secures the lead, and causes every following thread to be a repetition of the first.

Two dies of different diameters,† are employed to cut each screw; the one, fig. 24, fits the outside diameter of the cylinder to be screwed, and gives the screw a true lead; when this has cut about ¼ or ⅓ down, it is taken out, and another, fig. 25, supplies its place: this, as shown by the dotted circle, coincides with the bottom of the thread of the intended screw. Although the dies, being made in their places, are sure to produce a true screw; yet it is also necessary that the cylindrical parts, revolving in the chaps, O O, should be each of similar diameter, otherwise the screw would be taper. Should the threads, when cut, appear not exactly perpendicular to the axis of the cylinder, this error may be corrected by taking the cylinder out and reversing its position; and if the screw be passed against the die once, this operation will certainly equalize the threads.

Fig. 26 is a top view of the stock, N, and the die, M.

Fig. 27, a side view of the frame, the stock, N, and die, M, in it; the sliding plate and chaps, O, and the adjusting screw, Q.

39. To the above description, copied nearly verbatim from Mr. Allan's own statement, it may perhaps be as well, to point out two or three important particulars, on which the success of the operation mainly depends. 1st. Mr. A. found it essential to employ two dies of different diameter, in order that the large size should receive and fit the cylinder on which the screw is to be cut, at the commencement of the operation, when the first turn was sure to form a perfect screw; the whole of the teeth in this case being in contact at one and the same time with the part to be cut. It was however, necessary to finish the screw with the second or smaller die. 2nd. The insertion of a tooth into the first cut or thread, is a very ingenious and certain mode of insuring truth of work. 3rd. The correction of any error, however small, by reversing the screw, is a simple but effectual means of reducing that error, by subdivision, to so minute a quantity as to be inappreciable. Consequently a screw approximating perfection, as nearly as possible, could not fail, with ordinary care, to be produced.

The chief merit of the contrivance seems to depend on the accuracy with which three points of bearing may always be

* If this tool were required to cut a very long screw, it would be easy to arrange the apparatus, by means of a cross sliding piece and endless screw, so as to accommodate the chaps to almost any length.

† Two sets of dies are, we understand, now generally used in every case where a correct screw is required. Mr. Joseph Clement, whose name is a sufficient pledge for mechanical skill, adopted similar means to cut some very excellent screws of cast steel of considerable length, for straight-line dividing engines. These screws were found to much nearer truth, than those made in the usual manner, with one set of dies.

brought into contact—*videlicet*, two on each side of the cylinder, and one in the centre of the opposite side of it; so that it is almost, if not quite, impossible for any irregular bearing to take place, either during the cutting of the original screws or taps, or the dies cut by them in the tool, as during the process of cutting screws, whether tangent or for other purposes by the dies afterwards.

AN AMATEUR MECHANIC.

ON THE REGULATED SPEED OF THE LATHE-MANDRIL IN SURFACE-TURNING.

To the Editor of the Penny Mechanic and Chemist.

SIR,—It cannot, I apprehend, have escaped the observation of such of your readers as are in the habit of turning metal, that if a velocity exceeding certain prescribed limits, be imparted to the material, the edge of a cutting tool applied to reduce the surface of that material, is brought to a soft state and rendered obtuse. This is an acknowledged fact, and many ingenious contrivances have been, from time to time, introduced to meet the exigency of the case, or in other words, to regulate the speed of the lathe-mandril, according to the hardness and diameter of the metal or other substance to be turned. It is commonly supposed that for wood, the velocity cannot be too great: yet this, as may be easily proved, is a vulgar error; since, if we allow the speed to pass certain bounds, the tool necessarily becomes hot, loses its temper, and ceases to cut. Wrought iron requires a slow movement, and cast iron, above all, ceases to be affected by the edge of the tool; unless a very slow and regular motion is preserved, it appears to act as a stone, and actually grinds away the face of the tool.

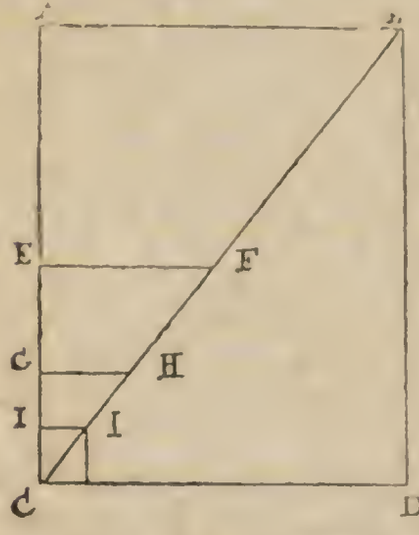
The opinion of practical men is much divided on this point—some name from ten to fifteen feet per minute, as a *maximum* velocity; others allow thirty to forty feet, whilst another party regard this as the *minimum* of speed, which should be given to cast iron, in order to obtain the greatest effect from the tool. As I have never made any experiments to determine the measure of velocity, I do not pretend to offer any opinion of my own.

For turning or boring cylinders, or indeed any substance of which the diameter is nearly equal throughout, a uniform motion fully answers the purpose; since the speed can easily be increased or diminished by means of conical pulleys placed in opposite directions, as also by many other mechanical appliances,* which are too familiar to practical men to require any extended description on this occasion. Suppose we have a cylinder of wood of considerable diameter to turn, we seek some method to control the speed; as, for instance, by diminishing the diameter of the fly-wheel, and increasing that of the pulley or mandril-wheel; by this means the motion is made slower, and in some respects in proportion to the diameter of the material. Had the cylinder been composed of cast iron instead of wood, we should have pursued a different course, and precisely the reverse of that we have just described. The facility afforded by two elongated cones, fixed in opposite directions as regards their respective diameters—the one attached to, or in immediate connexion with, the fly-wheel, and the other on the lathe-mandril—enables us to regulate the velocity with a precision that in many operations is of the highest importance; but it must be remembered that the advantageous effects of this arrangement are limited to the circumference or perimeter. If we have occasion to turn a plane surface accurately true, the motion of the lathe-mandril, or what is the same thing, the substance affixed to it, requires to be accelerated or retarded in a ratio proportioned to the progress of the tool either to or from its centre; then that portion of the plane where the tool takes effect, would pass its edge always at the same velocity; and, if a proper speed be obtained in the first instance, not only would the tool preserve its originally keen edge for a very considerable time, uninjured, but the surface produced by its action would be nearly perfect. This control and command of the movement obviously demand that it be continuous; since, if the lathe be stopped, a mark, or false cut as it is termed, will be the unavoidable result.

Under ordinary circumstances, regular motion in surface-turning is not only prejudicial in relation to its effects, but it also involves a great waste of time. We will suppose that a speed suitable for the circumference and the proximate parts is obtained, it is evident, as we approach the centre, the rotary movement becomes less effective; until at length, near the centre,

* Those who wish to investigate the subject, will gather much information from the specification of Mr. Bramah's patent, long since expired. See also the article in "Rees' Cyclopædia," on Expanding Riggers.

it produces little or none, and the work does not proceed at all. The reason of this is obvious—the velocity continues unaltered, while the diameter of the material is progressively reduced. It is also manifest as an inevitable consequence, to uniform motion in surface turning, that, presuming a suitable velocity be communicated when the tool is at the greatest distance from the centre of rotation, if it be made to advance regularly towards the same point—similar uniform speed being continued—the cutting edge of the tool would not, on its arrival at the centre, be more deteriorated, than if the velocity had been increased in a proportionate ratio to its progress towards the centre. This, I believe, is an admitted fact by competent judges; but we must remember, there would be a sacrifice of nearly *one-half* of the time employed—a consideration of no slight value, both to the principal and the workman. This statement, monstrous as it may appear, is nevertheless susceptible of mathematical demonstration—a mode of proof which, I presume, few will feel inclined to dispute.



Let the parallelogram, A B C D, represent the time that would be required to turn a surface. Draw the diagonal line, B C; bisect the line, A C, at E; E C, at G; and G C, at I; then draw the lines, E F, G H, and I J, parallel to A B.

Let C represent the centre; A C = the radius, and A B = the circumference, or time of one revolution at its greatest diameter; therefore the lines, E F, G H, and I J, will also represent their circumference or time of one revolution at their respective radii, as E, G, and I; and as the lines A B, E F, G H, and I J, are one-half the length of each other, so will their revolutions be performed in similar proportions of time, and the velocity of the lathe-mandril will be increased in the inverse ratio, as the length of the lines, A B, E F, G H, and I J; consequently the right-angled triangle, A B C, will represent the time that would be required to turn a surface, when the velocity of the lathe-mandril is increased in the manner already described. The parallelogram, A B C D, will represent the time that would be required if the velocity remain unaltered—that is, from the moment the tool is applied to the surface at its greatest diameter, to its arrival at the centre; for if the length of the line, A B, represent the time of one revolution at its greatest diameter, the line, C D, will in like manner represent the time of one revolution when the tool reaches the centre: therefore, as C D is equal in length to A B, so will all the intermediate revolutions be performed in similar equal spaces of time.

This inquiry may be usefully applied to determine the period of time necessary for surface-turning. Thus if we wish to know what time would be required to turn a plane surface of cast iron, the diameter being twenty-four inches, to make fifty revolutions or cuts in each inch of the radius, and to pass the tool at the rate of fifteen feet per minute—

Multiply the circumference, say 75.39 inches, by the radius = 12 inches; then multiply the product = 904.68 by the number of revolutions, or cuts in one inch of the radius, in this instance fifty; this will give 45234 inches; divide this by twelve, to reduce it to feet = 3769.5; divide again by fifteen, which gives 251.3 minutes, and dividing by sixty, we have 4 hours, 11.3 minutes; consequently this would be the time, if each revolution be performed in equal portions of time; but if the speed of the lathe-mandril be regulated, so that the surface to be turned shall always pass the tool at the same velocity, then the time will be only one-half of the above; for in this case we must multiply the radius by one-half of the circumference, as that will be a mean proportion of the lengths of all the intermediate revolutions.

Thus, sir, it is clear that the lathe is yet susceptible, notwithstanding the many and valuable improvements that have been made of late years, of some ingenious arrangement to govern the velocity of the mandril in surface-turning; particularly as this defect is universally admitted to be a grave and serious drawback in the performance of this otherwise beautiful and accurate machine; so much so, that I read only lately in a foreign scientific journal, of a workman who was compelled to stop his lathe, and accelerate the speed, no less than six times while turning a plane cast iron surface for a face-plate. This is a

subject worthy of the study of your readers; and, as such, I hope this brief statement will excite inquiry, and induce some skilful person to make known a simple mechanical combination, to meet the wants of the artizan, who is rarely in a position to afford expensive apparatus. I leave the matter in the hands of those who have more time to command than

Your obedient Servant,

AN AMATEUR MECHANIC.

HISTORY OF MEDALS.

(Continued from page 319.)

THAT Aurelian made some alteration in the coin is certain; but Mr. Pinkerton supposes it to have been only in the gold; because under him and his successor Probus, the common aureus was of 100 grains, a size confined to those emperors: there are likewise halves of about 50 grains; and double aurei, commonly of very fine workmanship, of upwards of 200 grains. In the time of Gallienus, the precious metal was so common, that this emperor vied in magnificence with Nero and Heliogabalus. Aurelian, who plundered the rich city of Palmyra, and thus became master of the treasures of the East, obtained such a profusion of gold, that he looked upon it to be produced by nature in greater plenty than silver. It is remarkable that, during this emperor's reign, there was a rebellion among the money-coiners, which could not be quelled but by the destruction of several thousands; which Mr. Pinkerton ascribes to his having ordered the gold to be restored to its former size, but to go for no more silver than it formerly did. "So very little silver (says he) occurs of this period, that it is plain no alteration in the silver produced the war with the moneyers; and in the brass he made no change; or if he had it were strange that such commotions should arise about so trifling a metal. But if, as appears from the coins, he ordered the aureus, which had fallen to eighty grains, to be raised to about 100, it is no wonder that the contractors should be in an uproar; for a whole quarter of their coinage, amounting as would seem, to all their profits, was lost. Aurelian judged that, when he found gold so common in the East, it was equally so in the West; and that the moneyers must have made a most exorbitant profit; but his ideas on this subject were partial and unjust: and after his short reign, which did not exceed five months after the alteration, the gold returned to its former course; though a few pieces occur of Aurelian's standard, struck, as would seem, in the commencement of the reign of Probus his successor.

From this time to that of Constantine I., the aureus weighed between seventy and eighty grains; but in his reign it was changed for the solidus, of which six went to the ounce of gold, which went for fourteen milliarenses, and twenty-five denarii as before; the value of silver being now to gold as fourteen to one. This new coin continued of the same value to the final downfal of the Constantinopolitan empire; gold being always very plentiful in that city, though silver became more scarce. The solidus was worth 12s. sterling. Here again our author most severely criticises Mr. Clark and Mr. Raper: the former (he says) with respect to the value of gold in the time of Constantine I. "has left all his senses behind him. In page 267, he absurdly asserts, that twenty denarii went to the solidus in the time of Theodosius I. and proceeds with this deplorable error to the end of his work. He then tells us, that only fourteen denarii went to the solidus under Constantine I." &c. To Mr. Raper, however, he is a little more merciful, as he owns, that "though he (Mr. Raper) has strangely confounded the milliarensis with the denarius, he has yet kept common sense for his guide." Mr. Pinkerton, indeed, argues with great probability, "that had any change in the coinage taken place between the time of Constantine and Theodosius I.—that is, in less than fifty years, the laws of that period, which are all in the Theodosian code, must have noticed it." To this and other arguments upon the subject, Mr. Pinkerton adds the following observation upon the value of gold and silver:—As a state advances to its height, gold increases in value; and as a state declines, it decreases, providing the metals are kept on a par as to purity. Hence we may argue, that gold decreased in its relation to silver perhaps four or five centuries, furnished most European kingdoms with gold in coin, which otherwise would, from their want of arts and of intercourse with the East, then the grand seminary of that metal, have almost been ignorant of what gold was. These gold coins were called Bezants in Europe, because sent from Byzantium or Constantinople; and were solidi of the old scale, six to the ounce. In Byzantine writers, the solidus is also called nomisma, or "the coin;" crysinos, because of gold; hyperperos, from its being refined with fire, or from its being of bright gold flaming like fire. The solidi also, as the aurei formerly, received names from the princes whose por-

traits they bore; as Michelati, Manuelati. Solidus is a term used also for the aureus by Apuleius, who lived in the time of Antoninus the Philosopher; nay, as early as the prætorian edicts of the time of Trajan. It was then a distinction from the semissis or half. In the time of Valerian, when aurei of different sizes had been introduced, it became necessary to distinguish the particular aurei meant. Hence in the imperial rescripts, published by the Historiæ Augustæ Scriptores, Valerian uses the term Philippeos nostri vultus, for the common aurei. Aurelian uses the same term aurei Philippei, for the aurei which he had restored to their size in some degree. Gallienus uses aurei Valeriani for his father's coins. Aurei Antoniniani are likewise put by Valerian for coins of the early Antonini, of superior standard to any then used.

In the first gold coinage at Rome, the aureus was divided into four parts: the semissis of sixty sestertii; the tremissis or third, of forty; the fourth, the name of which is not mentioned, of thirty; and the scrupulum of twenty. But in a short time all of these fell into disuse, except the semissis or half, which is extremely scarce; so that it is probable that few have been struck. It is an erroneous opinion (according to Mr. Pinkerton), that the semissis was called a denarius aureus. The aureus itself indeed had this name; but the name quinarius is applied to the semissis with greater propriety than the former. Trientes, or tremisses of gold, are found of Valerian and his son Gallienus, and weigh about thirty grains. Those of Salonina, the wife of Gallienus, weigh thirty-three grains. Under the Constantinopolitan empire, tremisses again made their appearance; and from the time of Valentinian downwards, the thirds are the most common kind of gold, being worth about 4s. sterling. The semissis is likewise mentioned, but none occur earlier than the time of Basiliscus. The gold tremissis was the pattern of the French and Spanish gold coins; as the silver denarius, in its diminished state, was of the Gothic and Saxon penny.

(To be continued.)

LAND MEASURES.

To the Editor of the Penny Mechanic and Chemist.

Sir,—In the article on Algiers wheat, in No. 98, the quantity one hectolitre, or $2\frac{3}{4}$ bushels, to be sown on one hectare, or 100 acres of land, must (as is remarked in the article) be a mistake. It arises in calling one hectare 100 acres, instead of 100 ares.

The are is the unity of land measure, adopted by the French in their truly scientific system of weights and measures, which we should do well to imitate; it is equal to a square of ten metres to a side.

The hectolitre is by the same system, 100 litres; the litre is equal to a cube of one decimetre, or $\frac{1}{10}$ of a metre to the side.

One decimetre cube of water is the weight of the kilogramme, which is, *de facto*, the unity of their weights, although by its name it is the gramme multiplied by 1000.

Thus in few words I have given a slight idea of the systematic arrangement of the Frence decimal weights and measures.

I have said advisedly a slight idea, because it gives but such a one of the profoundly scientific basis on which that system is formed. D. Rossy.

THE CHEMIST.

CHEMICAL ATTRACTION OR AFFINITY.

The terms attraction, or affinity, and repulsion, in the language of modern philosophers, are employed merely as the expression of the general facts, that the masses or particles of matter have a tendency to approach to, or to recede from, one another, and to unite to, or repel each other, under certain circumstances.

All bodies have a tendency or power to attract each other more or less, and it is this power which is called attraction.

Attraction is mutual, it extends to indefinite distances. All bodies whatever, as well as their component elementary particles, are endued with it. It is not annihilated, at how great a distance soever we suppose them to be placed from each other; neither does it disappear, though they be arranged ever so near each other.

The nature of this reciprocal attraction, or at least the cause which produces it, is altogether unknown to us. Whether it be inherent in all matter, or whether it be the consequence of some other agent, are questions beyond the reach of human understanding; but its existence is nevertheless certain.

That the power of attraction really exists is obvious from the slightest view of the phenomena of nature. It is proved with mathematical certainty that the celestial bodies, which constitute the solar system, are urged towards each other by

a force which preserves them in their orbits. It is farther proved beyond any doubt, that this planetary attraction is possessed not only by the heavenly bodies as wholes, but that it also extends to the smaller particles of which they are formed; as may be evinced by means of the following experiments.

1. If we place two or more globules of mercury on a dry glass or earthen plate, and push them gently towards each other, the globules will attract each other, and form one mass or sphere, greater in bulk, but precisely the same in nature.

2. If a plate of clean glass, perfectly dry, be laid on a large globule of mercury, the globule, notwithstanding the pressure applied to it, continues to preserve its spherical form; if we gradually charge the plate with weights carefully, the globule will be depressed and become thinner and thinner; but if we again remove the weights from the plate, the mercury will instantly recover its globular figure, and push up the glass before it.

In both these experiments we see that there exists an attraction between the particles of mercury; in the first, the globules which are in contact with the plate of glass leave this substance completely; they attract each other, and form a sphere greater in bulk. A mere inert fluid would in any case retain the figure it once possessed. It could not be endued with a globular form unless a real reciprocal attraction among its particles took place, which in the latter experiment is still more striking; for it there is not only superior to gravitation, but actually overcomes an external force.

3. If a glass tube of a fine bore be immersed in water, contained in any vessel, the fluid will ascend to a certain height within the tube above its level, and its elevation in several tubes of different sizes will be reciprocally as the diameter of their bores.

This kind of attraction which takes place as well *in vacuo* as in the open air, has been called capillary attraction. It is this attraction which causes water to rise in sponge, cloth, sugar, sand, &c.; for all these substances may be considered as fine tubes in which the fluid ascends.

The ascension of fluids in glass tubes of a fine bore succeeds best when the inside of the tube has been previously moistened, which may conveniently be done by blowing through it with the mouth. And if the water be coloured with a little red or black ink, its ascension will be more obvious, particularly if the tube be held against a sheet of white paper.

4. If two plates of glass, previously wetted, be made to meet on one side, and be kept open at the other, at a small distance, by the interposition of a shilling, or any other thin substance, and then immersed in water, the fluid will ascend between the two plates unequally. Its upper surface will form a curve, in which the heights of the several points above the surface of the fluid will be to one another reciprocally, as their perpendicular distance from the line in which the plates meet. The ratio of this attraction is therefore as the squares of the increments with which the plates open.

Here then we have two other instances that an attraction prevails among the particles of bodies. For in both cases part of the fluid has left the contiguous mass, contrary to the laws of gravitation. It is drawn up as it were, or attracted by the tube, or plate of glass.

5. If we immerse a piece of tin, lead, bismuth, silver, or gold, in mercury, and draw it out again immediately, the mercury will attract the metal, and the latter will carry with it a portion of the former, which will stick to it so obstinately as to be inseparable by mere friction.

There exists therefore an attraction between the different metals brought in contact with each other.

6. If a small stick be dipt in water, or any other fluid, and drawn out again, a drop will be found hanging at the end of it of a spherical form. The drop is spherical, because each particle of the fluid exerts an equal force in every direction, drawing other particles towards it on every side as far as its power extends.

Thus the very formation of drops obviously demonstrates that there must exist a cause which produces that effect. This cannot be gravity, for agreeably to experience that is rather an obstacle to the formation of drops; since, by the weight of the particles, large globules resting on solid bodies are flattened, and their regular spherical form prevented.

(To be continued.)

MISCELLANEA.

The Coal Mines of Lancashire.—It has been calculated that the coal beds of Lancashire, amount in weight, to the enormous sum of 8,400,000,000 tons; the total annual consumption of this coal, it has been estimated, amounts to 3,400,120 tons: hence it is inferred that the coal field of Lancashire, at the present rate of consumption, will last 2470 years.

The dredging machine used at Havre, in clearing the bed of the outer port, between the tower of Francis I., and the round point opposite, brought up, a few days ago, a fragment of a brass cannon weighing about 220 lbs. It appears to have been the but-end of a culverin, and bears on the breach the date of 1555, a few years after the foundation of Havre, in the reign of Henry II.; and a cypher formed of two letters, H, interlaced, which is engraven upon it, was probably that of King Henry. Its calibre is calculated for a six-pound ball, and, from the nature of its fracture, no doubt is entertained that the separation of the part was occasioned by an explosion. Although the fragment has probably laid in the mud for nearly three centuries, it is in very good preservation.

Sleep of Plants.—The leaves of Oxalis Bowie are compound and jointed, which permits considerable power of motion, and hence, when not stimulated by the light, the leaflets towards evening begin to recline and form a sort of cone, of which the summit of the petiole is the apex; as may be seen in leaves of the oxalis acetosella, or common wood-sorel. The flowers are also very sensible to light, and only expand thoroughly when the strong clear sunshine falls upon them. But they may be caused to open by the light of the lamp thrown upon them in a concentrated form by means of a lense, as was done by Monsieur Boryde St. Vincent, and so cheated out of their sleep. The term sleep of plants may excite surprise, but many plants exhibit phenomena analogous to the sleep of animals; and though it occurs to a greater or less extent in all plants, yet it is chiefly applied to those plants in which it is most perceptible—such as the Oxalis, and other members of the tribe Oxalidaceæ, and those of the Leguminosæ, especially the Robinia Pseudo-acacia, and the Mimosa pudica, and Mimosa sensitiva. —*The Botanist.*

An eminent French statistical writer once took his station near the staircase, at a London ball, for the purpose of ascertaining the proportion of gentlemen who arranged their hair with their fingers before entering the room. He found them to average about twenty-nine out of thirty; those who had least or most hair usually occupying most time.

French Manufactures.—France spins and weaves about 100,000 lbs. of cotton wool, or double within eighteen years, at a cost of 8d. per lb.; and she exports 2½ millions sterling of manufactures.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, September 14, W. Cox, Esq., on Natural Magic. Friday, September 16, J. H. Parry, Esq., on the Oratory of the French Revolution. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, Sept. 15, James Bennett, Esq., on his Method of Teaching Sight and Part Singing. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Sept. 12, — Chatterly, Esq., on Agricultural Chemistry. At a quarter-past eight o'clock.

QUERIES.

Can you or any of your correspondents tell me how to melt gold, so that it may be in a workable condition, without being brittle? J. C.

Can you tell me the best way to platinize silver? The electrotype way would, I suppose, be rather expensive, on account of the quantity of platinum required, which is rather dear.

X. Y. Z.

SIR,—I should feel obliged if any of your numerous correspondents would inform me of the meaning of a compensation balance to chronometers, and how it acts to prevent the action of different climates affecting the time, as I am informed it does, while passing through different climates. Is it a correct assertion, that a common watch stops while crossing the line or equator; and if so, what is the cause? How to make a blue writing-ink? J. C.

How spirits of salts are prepared for soldering; and the best mode of cleaning brass prior to lacquering? J. F.

Can you tell me how to prevent hair falling off or turning grey, also how to thicken it?

G. W. S.

A good method of testing the purity of tin, block and grain? I have lately had a pan made with tin sides and copper bottom, for the purpose of dyeing woollen; all the goods put into this pan to be dyed scarlet are spotted when they come out, and on this account I am anxious to know whether the cause is in the pan. J. B.

TO CORRESPONDENTS.

If S. Walter *will send the drawing and description of the engine, it shall be inserted.*

X. Y. Z.—*We shall feel great pleasure in inserting his communication, which, we doubt not, will be acceptable to our readers.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. **101**, THIRD SERIES. | SATURDAY, SEPT. 17, 1842. | No. 349, OLD SERIES.

APPARATUS FOR EXPERIMENTS ON THE ELASTICITY OF WIRES.

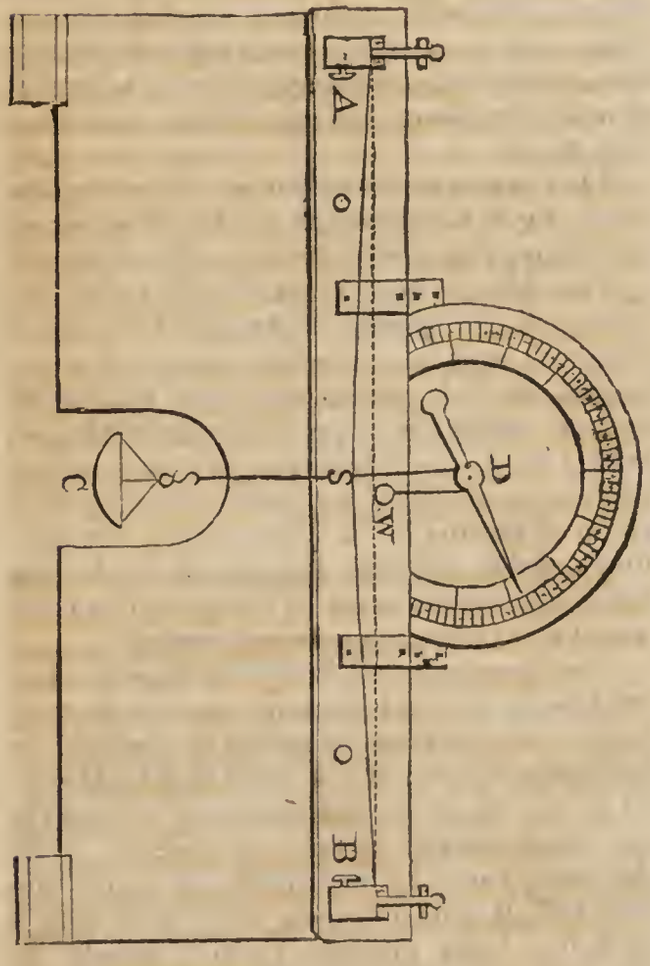


Fig. 3.

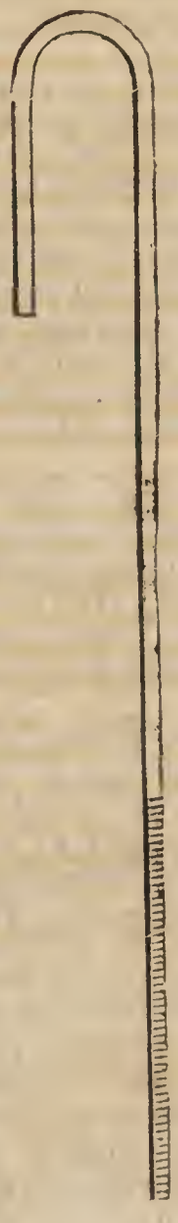


Fig. 2.

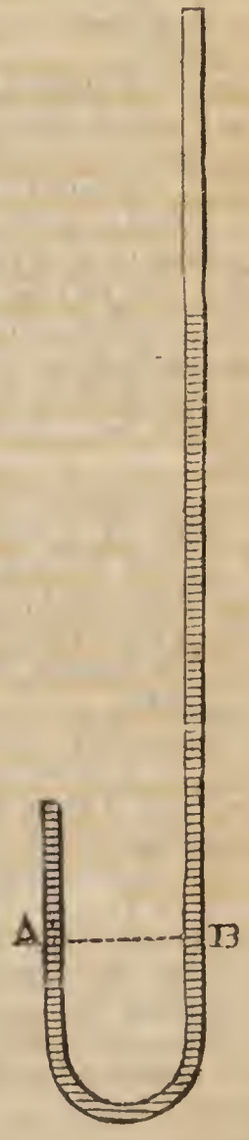


Fig. 1.

Vol. VIII.—No. 42] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

ELASTICITY.

(See Engravings, front page.)

Sir,—I think the subject of the accompanying paper, has not as yet appeared in any of the numbers of your excellent Magazine; and as it is one of great importance, more especially in the present day, I think a few words on it will not be amiss; hoping, at the same time, it will interest your numerous readers.

I remain, yours, &c,

H. H.

Description of the Engravings.

When certain substances have a force or pressure applied to them, which alters their natural position, and when, after the removal of this force, they return to their natural position again, the body is said to be elastic, and this property is called elasticity.

As may be supposed, bodies vary very much as to their elastic properties, some possessing perfect elasticity, while others will yield to rupture by the slightest bend.

India-rubber is very elastic; but when it is stretched to a great length, common experience tells us that it will not return to its first position, thereby showing that it is not perfectly elastic; similarly it is in a great many other substances, as glass, for when it is bent past a certain limit it will break.

Aeriform bodies, on the contrary, possess this property in a most perfect degree. This is shown by the following experiment, which was first proved by Marriotte:—He took a glass tube (fig. 1), which was hooked at the bottom, and was graduated into equal parts.

Let some mercury then be poured into the tube, till it reaches a height in the longer equal to the level of the metal in the shortest leg, viz., to the height, B; and at the same time observe the corresponding degree in the graduated scale. The confined air will then be of its ordinary density. Let then this quantity of mercury be doubled, the enclosed air will then be seen to occupy only half its space, owing to the pressure being double. If likewise, another equal quantity of mercury be added, the space will be found to be reduced to one-third. By increasing the pressure, the space occupied by the air, will be found to be diminished in the same proportion.

2. Let the tube be inverted (fig. 2), the space occupied by the included air, will be found to be increased, and it will be increased in the same proportion as it was diminished before, the pressure upon them being *inversely* to the space.

In all cases, therefore, immediately the pressure is removed, the air will return to its natural bulk.

This property of elasticity, is not only confined to aeriform bodies, but some have proved it of liquids. It has in fact, been supposed that aeriform bodies, are but liquids under a diminished state of pressure, so that by increasing the pressure upon them in a great degree, they may all be made to assume the liquid state.

The elasticity of the metals is one of great importance, and with which every one is conversant as contributing eminently to the resources of art, and ministering to the comforts of society. The following is the law which governs the elasticity of the metal:—when metals are extended or compressed, the force which they exert to recover their natural form, (viz. the force which is requisite to keep them extended or compressed), is proportional to the amount of the extension or compression, which has been communicated to them. Thus when a body has received double the extension or compression, it exerts double the force, triple, triple the force and so on.

This law was first proved in respect to wires, by S. Gravesande. The accompanying figure represents his apparatus (fig. 3).

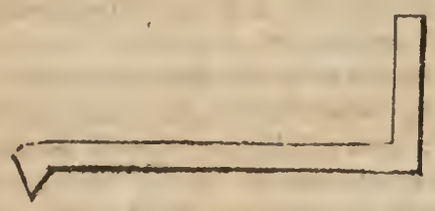
The wire, whose elasticity is to be determined, is placed between two fixed points, A and B. A scale pan, C, was attached to this wire, and was continued over a pulley, D, supporting a weight, W, acting as a counterpoise. To this pulley there was attached an index which pointed to divisions on a dial-plate. Exceedingly small weights being placed in the scale pan, the amount of deflection as each weight is put in, can be ascertained.

The elasticity of ivory is shown very strikingly in the following experiment:—Let a plane surface of metal or marble, be rubbed with oil; if an ivory ball be allowed to fall on it, it will rebound to nearly the same height that it fell from. Let the place then be examined on which the ball fell, it will be seen that not only a spot has been marked, (which would be the case if the ball had been gently put down), but a considerable surface has been formed, which will be greater as the ball is thrown from a greater height. We see from the rebounding then, that the ball must be elastic, and by the mark on the oil its compression is proved. Many other substances, such as metal, glass, stone, wood, &c., would produce the same phenomena.

The question which now occurs is, "what are the limits of elasticity?" It has been shown that when the particles of a body are displaced, they bend to return to their former position, with a force proportional to the displacement. That this may be the case, however, the displacement must be confined within very small limits. When these limits are surpassed, other particles occupying the space through which others have moved, another arrangement of particles is formed. In such a case, the body is said to take a "set." In conclusion, elasticity must be considered as very essential as regards its utility to mankind. Not only is it seen in the steam as used for the steam-engine, but in several other things: as the springs for watches, carriage springs, &c., all of which, tend very largely to our comfort and convenience.

To the Editor of the Penny Mechanic and Chemist.

SIR,—Your correspondent, A. M., solicits the attention of persons acquainted with screw-cutting, &c. I beg to offer my services in that little particular. There are many movements for screw-cutting in lathes; Fox's of Derby, is as simple and easy as any, but where there is no machinery for that purpose (and indeed there are more than one-half the factories without them); it is often troublesome to get good true threads by hand chasing tools, especially with some sorts of steel and iron; therefore I should advise him, for inside work in particular, to make a tool of the following description:—



It need not be more than seven inches in length, of $\frac{3}{8}$ by $\frac{5}{8}$ steel, turned round at one end about three inches, and the other as a diamond pointed tool as per drawing, a number of small holes or centre marks must be made in the end, say nine, in the three inches; the simple use of this tool is, to make a beginning for the screw tool by grasping it firmly in your hand. When laid on the top of a common rest, put the centre of the back poppet head into one of the centre marks, and advance the tool forward by means of the screw in the back poppet head, at the same time keeping a strain on the diamond point against your work, by having a number of holes or centre marks in the tail piece, you may suit any diameter that is wanted; and thus you attain a true thread with great facility. I am not aware that anyone has this sort of tool but myself, therefore you are at liberty to make what use of it you think proper. G. LODGE.

To the Editor of the Penny Mechanic and Chemist.

SIR,—Your correspondent, H. H., who supplied you with a drawing and description of a portable hand drill, which he calls Buchanan's, has not, I submit, quite behaved with that candour which ought to mark the contributions of men labouring in the field of science. The design and explanation of the tool referred to, is taken from an edition lately published, of Robertson Buchanan's tracts, by Mr. Weale of the Architectural Library, 59, High Holborn; it is entitled, "Practical Essay on mill-work, and other machinery, revised into a third edition with additions, by George Rennie, Esq., C. E. F. R. S." The distinguishing feature of this splendid volume, is unquestionably the series of beautifully engraved plates; showing the progressive improvements in that most useful and important class of machinery, designated TOOLS. Among the many exquisite specimens of modern ingenuity, all valuable and important, although of different degrees of merit, are some which display the highest degree of inventive genius; more particularly as regards boring and planing machines, and mechanical contrivances for cutting the teeth of wheels, both in the model and the metal. Screw-cutting engines, lathes, &c.

The portable hand-drill is delienated in pl. xxix., figs. 1 and 2; it was contributed by Messrs. Nasmyth, Gaskell, and Co., of Manchester; consequently I think it fair to assume the invention or arrangement, is due to one of the gentlemen comprised in that firm.

Now, sir, I put to you in common with every right-minded man, whether the simple principles of justice do not imperatively demand, that every writer should acknowledge in suitable terms, the source from whence he derives any information, whether in the shape of verbal description, or an illustrative design, matters not. To aim at novelty, either in mechanical or scientific literature, is, I am aware, an utter impossibility; we must be content to cull the sweets, prepared by other hands; all we can hope to achieve, particularly in the pages of a periodical, is to garner honestly and impartially from the rich

stores of genius, those facts which stand prominently forward, as most conducive from their practical utility to the interests and well-being of the working mechanic. I think I may venture to affirm, that both Mr. Rennie as editor, and Mr. Weale as publisher of a treatise which reflects infinite credit on the talent and assidnity of the one, and the generous enterprise of the other; I repeat, both these gentlemen would derive unmixed satisfaction from the circumstance that their efforts in mechanical literature, should be rendered yet more extensively useful through the medium of periodicals, supported by, and circulating principally among the workmen of England. I should apologise to you personally for the character of this letter, did I not know the editorial chair is anything but an easy seat, and that you cannot, in every case, individualise, as it were, the communications of your correspondents; a very large proportion, especially in a hebdomedal publication, must be taken upon trust! But, sir, while we profess to be liberal, and claim liberal treatment from others, let us not forget the golden apothegm, and "do unto others, as we would they should do unto us." Had your correspondent observed this law, indicated his authority, and bestowed on the work I have alluded to, that tribute of honest commendation, which is due alike to the editor and the publisher, he would have performed an act of justice, and spared you the trouble of reading these lines of expostulation,

from yours obediently,

AN AMATEUR MECHANIC.

[WE insert this letter, hoping that the substance of it will be borne in mind by our correspondents generally. As we cannot probably in all cases decide as to the originality of a communication, we are obliged to take a great deal on trust, and therefore embrace this opportunity of requesting (as we have done many times), that our friends will, in all cases, name their works of information, which will save us a great deal of trouble, will be doing justice to those who deserve it, and will not be less beneficial or acceptable to our readers. We cannot however go so far as to attach blame to our friend H. H., in the present instance: as he no doubt, thought that the name of the inventor would be quite sufficient to show that it was not original, without calculating on the justice due to G. Rennie, Esq., the reviewer of the present edition.—ED.]

HISTORY OF MEDALS.

(Continued from page 325.)

WE shall close this account of the Roman money with some remarks concerning the mint, and method of coinage. This at first seems to have been under the direction of the quæstor. About the time that silver was first coined in Rome, viz. about 266 B. C. the triumviri monetales were created. They were at first of senatorial rank, but were by Augustus chosen from among the equestrian; and the title of triumviri was continued till after the time of Caracalla; but under Aurelian there was probably but one master of the mint, called rationalis; and Mr. Pinkerton is of opinion that the charge took place under Gallienus. He seems also to have permitted the provincial cities to coin gold and silver, as well as to have altered the form of the mints in the capital, and to have ordered them all to strike money with Latin legends, and of the same forms; as in his time we first meet with coins with mint marks of cities and offices. The violent insurrection which took place in his reign has already been mentioned, as well as its probable cause; and Mr. Gibbon has shown, that the concealed enemies of Aurelian took such advantage of this insurrection, that it cost 7000 of his best troops before it could be quelled. About this time the procurator monetæ seems to have succeeded the rationalis as director of the mint. In the colonies, the direction of the mint seems to have been given to the decemviri, whose names frequently occur in colonial coins; "which (says Mr. Pinkerton), though generally of rude invention, and rude execution, are yet often interesting and important."

The engraving of the ancient dies used in coinage was a work of much genius and labour; and at Rome Greek artists were generally employed in it; but it has been thought a matter of great surprise, that scarce any two ancient coins are to be found exactly the same. Hence some antiquaries have imagined that only a single coin was thrown off from each die. M. Beauvais informs us, that the only two Roman imperial coins of the first times which he had seen perfectly alike, were those of the emperor Galba. It is, however, the opinion of the best judges, that a perfect similarity betwixt two medals, is a very great reason for supposing one of them to be forged. "It must also be observed (says Mr. Pinkerton), that the differences in coins, apparently from the same die, are often so minute as to escape an eye not used to microscopic observa-

tions of this sort. But it would be surprising if any two ancient coins were now found struck with the same die; for out of each million issued, not above one has reached us. Dies soon give way by the violence of the work, and the ancients had no puncheons nor matrices, but were forced to engrave many dies for the same coin. Even in our mint, upon sending for a shilling's-worth of new halfpence, it will appear that three or four dies have been used. Sometimes the obverse of the die gives way, sometimes the reverse; but among us it is renewed by puncheons, though with variations in the lettering or other minute strokes; while the ancients were forced to recur to another die differently engraven. The engravers of the die were called cælatores; other officers employed in the mint were the spectatores, expectatores, or nummularii. The melters were styled fusarii, flatuarii, and flatnrarii; those who adjusted the weight were called æquatores monetarum; those who put the pieces into the die supposito-res, and those who struck them malleatores. At the head of each office was an officer named primicerius, and the foreman was named optio et exactor."

In order to assist the high relief on the coins, the metal, after being melted and refined, was cast into bullets, as appears from the ancient coins not being cut or filed on the edges, but often cracked, and always unequal. These bullets were then put into the die, and received the impression by repeated strokes of the hammer, though sometimes a machine appears to have been used for this purpose: for Boiterue informs us, that there was a picture of the Roman mintage in a grotto near Baiæ, where a machine was represented holding up a large stone as if to let it fall suddenly, and strike the coin at once. None of the ancient money was cast in moulds, excepting the most ancient and very large Roman brass, commonly called weights, and other Italian pieces of that sort; all the rest being mere forgeries of ancient and modern times. Some Roman moulds which have been found are a proof of this; and from these some medallists have erroneously imagined that the ancients first cast their money in moulds, and then stamped it, in order to make the impression more clear and sharp.

The ancients had some knowledge of the method of crenating the edges of their coins, which they did by cutting out regular notches upon them; and of this kind we find some of the Syrian and ancient consular coins, with a few others. The former were cast in this shape, and then struck; but the latter were crenated by incision, to prevent forgery, by showing the inside of the metal; however, the ancient forgers also found out a method of imitating this; for Mr. Pinkerton informs us, that he had a Roman consular coin, of which the incisions, like the rest, were plated with silver over the copper.

We now come to consider what it is that distinguishes one medal from another, and why some are so highly prized more than others. This, in general, besides its genuineness, consists in the high degree of preservation in which it is. This, by Mr. Pinkerton, is called the conservation of medals, and is by him regarded as good and as perfect. In this, he says that a true judge is so nice, that he will reject even the rarest coins if in the least defaced either in the figures or legend. Some, however, are obliged to content themselves with those which are a little rubbed, while those of superior taste and abilities, have in their cabinets only such as are in the very state in which they came from the mint; and such, he says, are the cabinets of Sir Robert Austin, and Mr. Walpole, of Roman silver, at Strawberry hill. It is absolutely necessary, however, that the coin be in what is called good preservation; which in the Greek or Roman emperors, and the colonial coins, is supposed to be when the legends can be read with some difficulty; but when the conservation is perfect, and the coin just as it came from the mint, even the most common coins are valuable.

The fine rust, like varnish, which covers the surface of brass and copper coins, is found to be the best preserver of them; and is brought on by lying in a certain kind of soil. Gold cannot be contaminated but by iron mold, which happens when the coin lies in a soil impregnated with iron; but silver is susceptible of various kinds of rust, principally green and red; both of which yield to vinegar. In gold and silver coins the rust must be removed, as being prejudicial; but in brass and copper it is preservative and ornamental; a circumstance taken notice of by the ancients. "This fine rust (says Mr. Pinkerton), which is indeed a natural varnish not imitable by the art of man, is sometimes a delicate blue, like that of a turquoise; sometimes of a bronze brown, equal to that observable in ancient statues of bronze, and so highly prized; and sometimes of an exquisite green, a little on the azure hue, which last is the most beautiful of all. It is also found of a fine purple, of olive, and of a cream colour or pale yellow: which last is exquisite, and

shows the impression to as much advantage as paper of cream colour, used in all great foreign presses, does copper-plates and printing. The Neapolitan patina (the rust in question) is of a light green; and when free from excrescence or blemish is very beautiful. Sometimes the purple platina gleams through an upper coat of another colour, with as fine effect as a variegated silk or gem. In a few instances a rust of a deeper green is found; and it is sometimes spotted with the red or bronze shade, which gives it quite the appearance of the East Indian stone called the *bloodstone*. These rusts are all, when the real product of time, as hard as the metal itself, and preserve it much better than any artificial varnish could have done; concealing at the same time not the most minute particle of the impression of the coin."

THE CHEMIST.

CHEMICAL ATTRACTION OR AFFINITY.

(Continued from page 327.)

To explain this phænomenon there remains only the power of attraction, acting between the particles of the liquid body; for if it is supposed that the particles of a substance reciprocally attract each other with equal force, and their aptitude for being moved upon one another be great enough to overcome any impediment to their motion, it follows by the principles of mechanics, that the equilibrium of the attractive forces can only take place when the mass has received a globular form.

Hence it is that all liquid bodies assume a spherical figure when suffered to fall through the air, or form drops.

Though we are unable to discover the cause of the mutual attraction, experience has proved to us that this agency follows certain conditions or laws; for similar phenomena always present themselves, whenever the circumstances of experiment are the same.

Observation has taught us that attraction takes place between bodies of the same kind, and bodies of a different kind. The first is called *attraction of aggregation*, also *corpuscular attraction; molecular attraction;* and *attraction of cohesion*, or the *cohesive power*.

The latter is termed *chemical attraction*, *chemical affinity* or *affinity of composition*.

Corpuscular attraction, or attraction of cohesion or aggregation, is that power by means of which the similar particles of bodies attract each other, and become united into one mass, without changing in the least the chemical properties they possessed before their union. The bodies may be in a solid, fluid or aeriform state.

This attraction is different in different bodies. It is always in an inverse ratio to the power of repulsion, or the quantity of caloric interposed between the particles of the acting bodies.

It becomes obvious from this, that the agency of attraction of aggregation, consists in a mere successive and constant accumulation of similar particles into one mass; and that it produces adherence of surface, or apparent contact in the ratio of the surfaces.

This force is inherent in all the particles of all bodies (caloric and light perhaps excepted); we never find the particles of bodies in a detached state, but constantly in masses of greater or smaller magnitude, made up of an indefinite number of particles united together by virtue of the force of cohesion.

The simplest case of the exertion of the attraction of aggregation is, that where two bodies placed in mutual contact with each other form a direct union, without changing their chemical properties: thus, if different particles of sulphur be melted together, they form a uniform mass or whole, the particles of which are held together by virtue of the power of attraction of aggregation, but the properties of the body are not altered.

The same effect takes place when pieces of the same metal, or particles of resin, wax, &c. are united in a similar manner.

The force of this attraction in solid bodies may be measured by the weight necessary to demolish it. Thus if a rod of metal, glass, wood, &c. be suspended in a perpendicular direction, and weights be attached to its lower extremity till the rod is broken by them, the weight attached to the rod just before it broke, is the measure of the cohesive force of the rod.

1. The agency of attraction of aggregation acts, only at insensible distances; its force increases as the distance of the bodies presented to each other decreases, and as the surface of apparent contact are more numerous: thus, if we take two sections of a leaden ball, having each a flat and smooth surface, and press them forcibly together, they will cohere, and a considerable effort is necessary to force them asunder: so also two plates of glass wetted with a little water to fill up their inequalities, when laid together, will cohere: and two pieces of marble having each a flat, smooth, and well polished sur-

face, when moistened and slipt upon each other with a gentle pressure, will unite, and a considerable force is required to separate them. But if the two substances placed together, be not sufficiently smooth or polished, it will be in vain to try to cause them to adhere together, for this reason, that the particles touch each other only in a few points: whereas on the contrary, the particles of the former flat and smooth surface touch each other in many points. It has been noticed that a silk-worm's thread can be interposed, but not two.

The pressure of the atmosphere has no influence on these experiments, for they succeed equally well *in vacuo* as in the open air.

It is on this account that carpenters, when they intend to glue pieces of wood together, plane the surfaces perfectly smooth before they apply the glue; and that the surfaces of metals are scraped clean before they are soldered, &c.

Hence the attraction of aggregation always vanishes whenever the distance is measurable, and becomes exceedingly great whenever the distance is exceedingly diminished; but the particular rate which this power follows, is still unknown, as we have no method of measuring either the distance at which it acts, or its relative intensity.

2. Attraction of aggregation acts differently in different bodies; according to the degree of force with which it acts between the particles of matter, the bodies appear under different forms.

It is on this account that rock-crystal, flint, diamond, and various other precious stones are extremely hard, for the attraction of aggregation unites the particles of these bodies with a great degree of force. Hence a considerable mechanical effort is necessary to disunite them.

In blocks of marble, chalk, lime-stone, &c. the particles are held together with a force considerably less. In these bodies it prevents all relative motion among the particles themselves, and hence the motion of one particle is followed by the motion of the whole mass; or if that is impossible, the cohesion is destroyed altogether, and the piece breaks.

The integrant parts of wax, tallow, suet, or lard, may be made to change their situations, with a less degree of force than the former.

In these substances the motion of one particle of the body is not necessarily followed by that of all the rest, neither does that motion destroy the cohesion, nor break them.

The particles of water, spirit, and ether, move or slide over each other very readily; hence their resistance is considerably less.

And lastly, vapours, the air of the atmosphere, and all the gasses, yield to the slightest possible impulse.

3. Attraction of aggregation may be annihilated by every effort which tends to separate the particles of bodies.

It need hardly be mentioned that all mechanical forces, such as grinding, cutting, filing, rasping, pounding, breaking, &c., are of this nature.

In all these cases the force applied must be more than equal to the force of the attraction; and, as it was stated before, that the attraction of aggregation acts with different degrees of force between the particles of different bodies, so different degrees of force are necessary to destroy that attraction in different bodies; and hence it is that chalk is more easily reduced to powder than flint; wood is easier broken than lead; lead easier than iron, &c.

Chemical affinity, or affinity of composition, is that power, by means of which the particles of bodies, whether simple or compound, attract each other so intimately as to produce an uniform whole, totally inseparable by mechanical efforts, and whose characterestic properties are often different, and sometimes contrary to those of its constituent parts.

It is obvious from this, that the particles of those bodies which are united by virtue of chemical affinity, form not a mere aggregate, but an entire new body, which can only be altered by the action of another chemical power.

In considering this kind of affinity, it will be necessary to state;—In what manner it takes place between the particles of different bodies;—In what proportion they are capable of combining;—Under what condition;—With what degree of force they unite;—And what takes place when a variety of different substances are made to act upon each other at the same time, under certain circumstances and in different proportions.

Hence chemical affinity is of greater importance than affinity of aggregation, for it takes place in all the complex operations of chemistry.

To prove that chemical affinity acts differently from attraction of aggregation; that it takes place between the ultimate constituent parts of bodies; and that it produces substances possessing properties, frequently very different, and sometimes contrary to those of the constituent parts, the following experiments may serve.

(To be continued).

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 20, Southampton Buildings, Chancery Lane.—Wednesday, September 21, W. Cox, Esq., on Natural Magic. Friday, September 23, J. H. Parry, Esq., on the Oratory of the French Revolution. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, Sept. 22, E. Clarkson Esq., on Egyptian Antiquities. At half-past eight.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Sept. 19, Mr. Harwood, on the Morality of the Drama. At a quarter-past eight o'clock.

QUERIES.

"G. S. Jun." would oblige by informing me what preparation organ builders use, to render the wind-box, bellows, &c., air-tight, the wood being porous? P. H.

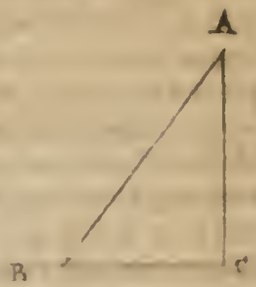
In your excellent Magazine of July 30, L. G. has explained the way in which gun-barrels are made, and the cause of the brown shading or real twist, by being welded in stripes and forced into a spiral form and acted upon by muriatic acid &c. But I fancy what W. W. meant by the *sham or mock twist*, is what I am in quest of myself, and shall be much obliged to any of your correspondents, if they will give me the information, that is:—How to produce the brown shaded stain upon the surface of plain made gun-barrels, so as to give them the appearance of the real twist? 2. How is ivory black made, and by what means am I to test its genuineness? 3. What is the best means employed to render old castings (cast iron) malleable? BATTY.

What is the simplest and least injurious method of stupefying common hive-bees, for about fifteen or twenty minutes, at the end of which time I would wish them to completely recover? 2. How to make mixtures for permanently staining the hair of dogs from white to black, red, and brown colours, without injuring the skin? O. M.

1. What is the best thing to dye curriers leather a permanent dead black? 2. How is oil of hartshorn made? 3. How are the black and blue colours made that are used by calico printers? 4. A receipt for making the essence of mille fleurs? [This article is imported from France, and cannot be properly made in this country. ED.] 5. How to make the best kind of perfumed hair oil? [The finest olive oil scented with otto of roses or bergamot. ED.] 6. What is the best thing to harden any kind of edge tools, to enable them to cut marble or porphyry without bending or breaking into pieces? 7. A receipt for making shoe-makers' heel-balls? 8. How is the ung nicotiane made? 9. Directions for making a substitute for yeast in making bread, &c.? 10. In what proportions may the carbonate of ammo, or the acetate of potash, be used with flour, &c., to produce light, wholesome, and nutritious bread? PHILOMELA.

ANSWERS TO QUERIES.

"E. L." 3. How to find the distance of an object by trigonometry? Suppose A is the object, ∠ C is 90°, ∠ B 80°, and the distance, B C, two chains twenty links, required the distance of the object from B.



There are various formula by which it may be solved, the following may serve as examples:—

1st. With B as a centre, and, B A, as radius, cosine ∠ B, 30° : 220 links :: radius : A B.

Log. of radius	10.00000
Log. of 220	2.34242
	12.34242
Log cosine 80°	9.23967
A B = 1267 links as 12 chains 67 links =	3.10275

2nd. With B as a centre, and B C as radius, radius : 220 :: secant of 80° : A B.

Log. of secant of 80°	10.76033
Log of 220	2.34242
	13.10275
Log of radius	10.00000
A B = 12 chains 67 links =	3.10275

3rd. A as centre, and A C as radius, Tang. ∠ A 10° : 220 links : secant 16 : A B

Log secant 10°	10.00665
Log. 220	2.34242
	12.34907
Log. tang 10°	9.24632
as before	3.10275

There are various other forms, for which, see "Keith's Trigonometry, &c." The *secants* are found by subtracting the cosine from 20.0000; and the *cosecants* by taking the sines from the same number. G. P., Jun.

There is a very valuable and *very cheap* table of logarithms, published by Walton and Taylor, Gower Street, opposite the London University.

TO CORRESPONDENTS.

J. C. Hoxton.—*His communication has either not reached us, or has been mislaid; if he will send us the queries they shall be inserted. Seven vols. of* THE MECHANIC *have been published, all of which, as well as the back Numbers, may be obtained of the publisher or any bookseller.*

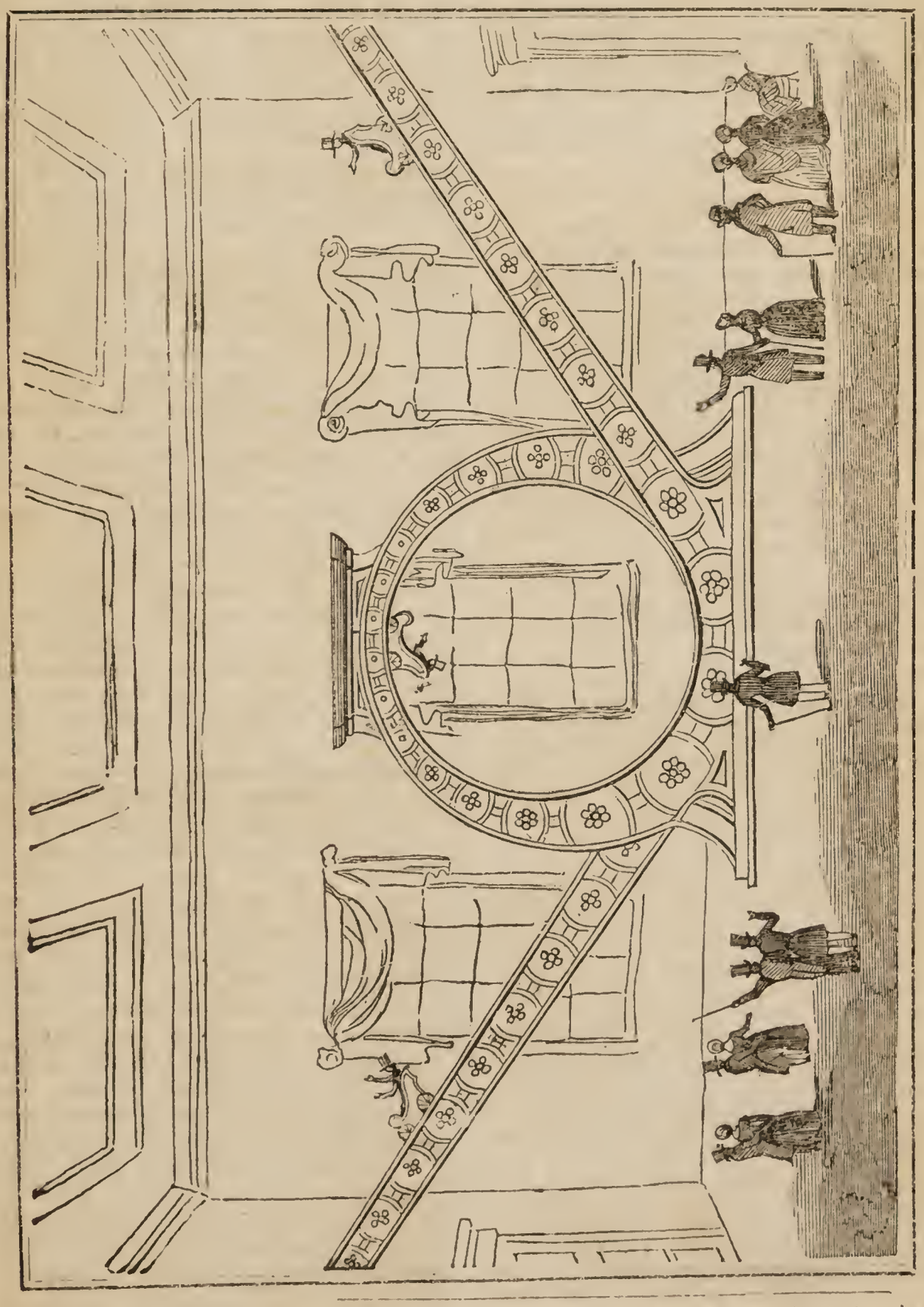
London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. **102**, THIRD SERIES. | SATURDAY, SEPT. 24, 1842. | No. 350, OLD SERIES.



CENTRIFUGAL RAILWAY.

Vol VIII.—No. 43.] [City Press, 1, Long Lane, Aldersgate Street. D. A. Doudney.

THE FLYING RAILWAY,

EXHIBITING AT THE EGYPTIAN HALL, PICCADILLY.

(See Engraving, front page.)

THE railway consists of two inclined planes, and a circle of between forty and fifty feet in circumference, rising fourteen feet perpendicular from the floor, making the whole line 160 feet in length. The carriage descends the line, passes the circle, and ascends the other inclined plane, travelling at a prodigious rate.

The fête has at first a very fearful effect upon the spectators. The impetus given to the carriage in descending the inclined plane, awakens the keenest apprehension for the safety of the traveller, who in the space of about twenty seconds, travels the whole length of the line.

THE GREAT BRITAIN.—THE LARGEST VESSEL IN THE WORLD.

SOME few particulars respecting this immense iron steam-ship, the largest vessel in the world, now building by the Great Western Steam-ship Company at Bristol, and which will be ready for sea in the early part of next year, cannot fail to be interesting at this period, when the questions of transatlantic steam-navigation and of our communications with India, form prominent subjects of discussion.

The Great Britain is built entirely of iron, with the exception of the flooring of her decks, and the flooring and ornamental parts of her cabins. She is 324 feet in length aloft, or upwards of 100 feet longer than our largest line of battle ship. Her extreme breadth is 51 feet, and the depth of her hole 32 feet. She is registered 3,200 tons, so that her bulk far exceeds that of any two steamers in the world. She has four decks, the lowest of which is of iron, and appropriated for the reception of the cargo. The upper deck, with the exception of a small break in the forecastle, is completely flush from stem to stern, without building or elevation of any kind, so that, besides the masts and funnel, there will be nothing above deck to offer resistance to a head wind. The two intermediate decks are appropriated exclusively to the use of passengers and the equipage of the ship, and consist of four grand saloons, forming together a length of dining room of 350 feet, two large ladies' cabins or family rooms, and 150 state rooms, each containing two spacious sleeping berths, so, that, besides the portion appropriated to the crew, steward's department, &c., the immense number of 360 passengers can be accommodated each with a separate bed, without requiring a single sofa to be made up in any of the saloons. The principal saloon is 103 feet long by 32 feet wide and eight feet three inches high. Besides the vast space appropriated to the passengers, crew, &c., and that occupied by the engines, boilers, &c., she has sufficien room for the stowage of 1,000 tons of coals, and 1,200 tons of measurement goods. There are three boilers, capable of containing 200 tons of water, which will be heated by 24 fires, and she has four engines, each of 250 horse power, making in all 1,000 horse power. Some idea may be formed of her vastness, when I state that 1,400 tons of iron have been used in her construction. The most novel feature about the Great Britain is her mode of propulsion, which is by the newly improved screw-propellor, patented by Mr. Smith, of London, (with improvements made upon it), and applied by that gentleman with complete success to the Archimedes. With a view to ascertaining the power of the screw, as compared with paddles, the Archimedes was hired by the Great Western Company, and a series of experiments made with screws of various size and form; and it being found that fully an equal velocity, with an equality of power, could be obtained as with paddles, conferring a great advantage under adverse circumstances, particularly in strong head winds, the machinery at the same time being infinitely more simple, and at no time an encumbrance to the vessel, it was resolved not to use the paddles in the Great Britain, but to adopt the screw, with the improvements which had been made in the course of the various experiments with the Archimedes. The screw with which she will be fitted will be 16 feet in diameter, and placed under the stern, between the stern post and the run of the ship, in which situation it will be quite out of the way of injury. It is calculated that this substitution of the screw propeller for the paddles will relieve the Great Britain of 100 tons of top weight, and admit of the boilers and engines being adjusted in that part of the ship which is best suited to receive them, and where they best act as permanent ballast. The Great Britain will be fitted with six masts, on five of which a single fore and aft sail only will be carried, the mainmast alone being rigged with yards and topmast. These masts will be low as compared with the size of the vessel, although the mainmast will be 97 feet long, and the quantity of canvass, though inconsiderable to

what she would carry as a full rigged ship, will still be as much as would cover three-quarters of an acre of ground. Her decorations are intended to be in the first style of nautical embellishment. It remains only to speak of the speed and qualifications which may be looked for in this large ship and the services she may be expected to accomplish. It is difficult to ascertain the precise limits of the speed which she is calculated to perform at sea. Probably the expectations of the directors are greater on this point than they choose to confess until an actual trial, but something considerably exceeding that of any sea-going steam-ship at present afloat may be looked for. The rate at which the Oriental steam-vessels accomplish their voyages does not average more than eight miles an hour; the Atlantic steamer about nine, and the most rapid sea voyage yet accomplished has not exceeded an average of ten miles an hour. It is estimated that the Great Britain will accomplish from ten to sixteen miles an hour, according to the nature of the weather and the sea, and no doubt is entertained but that her average will be at least twelve to thirteen miles per hour; taking the lowest of these rates, there would be an amazing increase over the greatest triumphs of steam navigation hitherto heard of. Let us consider some of the advantages which might accrue to this country by the success of the Great Britain. Our overland mail is now received by us by the favour alone of jealous neighbours in Europe and of semi-barbarians in Africa. By these means alone is our overland correspondence and our passengers to and from India transmitted in about thirty-five days, at a great expense and inconvenience, in various transhipments and intermediate land carriage, subject to many annoyances and anxieties; our Indian correspondence liable to be intercepted and all communication cut off for at least a month at any moment that either of these powers to which we have alluded might choose to do so. Who then can properly estimate the value of our being able to secure, in defiance of the world, the same expedition by our old and rightful track round the Cape of Good Hope? And by the Great Britain this may be done, for she would be able to deliver the despatches and upwards of 1,000 troops if necessary, at any point between the banks of the Indus and the mouth of the Ganges in from thirty-five to forty days. Allowing her consumption of coals to be fifty-five tons per day to secure an average of twelve miles an hour, she could dispensing with goods carry forty days' stock of coals without occupying the least portion of the space appropriated to the officers, crew, and passengers of the ship, or adding an iota to her regular lading and draught of water, in which time by following out the calculation she would have run a distance of 12,000 miles; besides, should the patent fuel be found to answer, she would be able to carry upwards of 60 days' stock. In the Indian Seas, too, it must be remembered, there are advantages not to be found in the North Atlantic, in which nothing is more common than for a vessel to have head to wind during the whole outward passage to America, and consequently the steamer traversing it has to often battle with the elements the entire way. In the tropics, on the contrary, the presence of the trade winds enables the commander to calculate with certainty on performing a very large portion of his voyage at the very *maximum* of speed. When it is considered that after making a liberal allowance from these calculations, this steamer is so constructed as to sail with great rapidity, having a fair wind, there being no paddles to drag along, and no hinderance from the screw, there is no saying what length of voyage she might not accomplish with great expedition without a ralay of fuel: and it must be granted the experiment is of vast importance in a national point of view.—*Times.*

HISTORY OF MEDALS.

(Continued from page 334.)

The value of medals is lowered when any of the letters of the legend are misplaced; as a suspicion of forgery is thus induced. Such is the case with many of those of Claudius Gethieus. The same, or even greater, diminution in value takes place in such coins as have not been well fixed in the die, which has occasioned their slipping under the strokes of the hammer, and thus made a double or triple image. Many coins of this kind are found in which the one side is perfectly well formed, but the other blundered in the manner just mentioned. Another blemish, but of smaller moment, and which to some may be rather a recommendation, is when the workmen through inattention have put another coin into the die without taking out the former. Thus the coin is convex on one side, and concave on the other, having the same figure upon both its sides.

The medals said by the judges of this science to be countermarked are very rare, and highly valued. They have a small

stamp impressed upon them, in some a head, in others a few letters, such as AUG; N. PROBUS, &c. which marks are supposed to imply an alteration in the value of the coin; as was the case with the countermarked coins of Henry VIII. and Queen Mary of Scotland. Some have a small hole through them; sometimes with a little ring fastened in it, having been used as ornaments; but this makes no alteration in their value. Neither is it any diminution in the value of a coin that it is split at the edges; for coins of undoubted antiquity have often been found in this state, the cause of which has been already explained. On the contrary, this cracking is generally considered as a great merit; but Mr. Pinkerton suspects that one of these cracked coins had given rise to an error with respect to the wife of Carausius who reigned for some time in Britain. The inscription is read ORIUNA AUG: and there is a crack in the metal just before the O of oriuna. Without this crack Mr. Pinkerton supposes that it would have been read FORTUNA AUG.

Some particular soils have the property of giving silver a yellow colour as if it had been gilt. It naturally acquiries a black colour through time, which any sulphureous vapour will bring on in a few minutes. From its being so succeptible of injuries, it was always mixed by the ancients with much alloy, in order to harden it. Hence the impressions of the ancient silver coins remain perfect to this day, while those of modern coins are obliterated in a few years. On this account Mr. Pinkerton expresses a wish that modern states would allow a much greater proportion of alloy in their silver coin than they usually do. As gold admits of no rust except that from iron above mentioned, the coins of this metal are generally in perfect conservation, and fresh as from the mint.

To cleanse gold coins from this rust, it is best to steep them in aquafortis, which, though a very powerful solvent of other metals, has no effect upon gold. Silver may be cleansed by steeping for a day or two in vinegar, but more effectually by boiling in water with three parts of tartar and one of sea salt; on both these metals, however, the rust is always in spots, and never forms an entire incrustation as on brass or copper. The coins of these two metals must never be cleansed, as they would thus be rendered full of small holes eaten by the rust. Sometimes, however, they are found so totally obscured with rust, that nothing can be discovered upon them; in which case it is best to clear them with a graver: but it may be also done by boiling them for twenty-four hours in water with three parts of tartar and one of allum; not sea salt as in silver coins.

The high state of preservation in which ancient coins are usually found, is thus accounted for by Mr. Hancarville. He observes, that the chief reason is the custom of the ancient always to bury one or more coins with their dead, in order to pay for their passage over the river Styx. "From Phidon of Argos (says he) to Constantine I. are thirty-six generations: and from Magna Græcia to the Euphrates, from Cyrene to the Euxine sea, Grecian arts prevailed, and the inhabitants amounted to above 30,000,000. There died, therefore, in that time and region, not less than 10,000 000,000 of people, all of whom had coins of one sort or other buried with them. The tombs were sacred and untouched; and afterwards neglected, till modern curiosity or chance began to disclose them. The urn of Flavia Valentina, in Mr. Towley's capital collection, contained seven brass coins of Antoninus Pius and Heliogabalus. Such are generally black, from being burnt with the dead. The best and freshest coins were used on these occasions from respect to the dead; and hence their fine conservation. At Syracuse a skeleton was found in a tomb, with a beautiful gold coin in its mouth; and innumerable other instances might be given, for hardly is a funeral urn found without coins. Other incidents also conspire to furnish us with numbers of ancient coins, though the above-recited circumstance be the chief cause of perfect conservation. In Sicily, the silver coins with the head of Prosepine were found in such numbers as to weigh 600 French livres or pounds. In the sixteenth century, 60,000 Roman coins were found at Modena, thought to be a military chest hid after the battle of Bedriacum, when Otho was defeated by Vitellius. Near Brest, in the year 1760, between 20,000 and 30,000 Roman coins were found. A treasure of gold coins of Lysimachus was found at Deva on the Marus; and Strabo, lib. vii. and Pausan. in Attic. tell that he was defeated by the Getæ; at which time this treasure seems to have fallen into their hands."

Thus Mr. Pinkerton, from the authority of Mr. Hancarville and others; but considering these vast numbers of coins found in various places, it seems surprising how so few should now remain in the cabinets of the curious, as the same author informs us that the whole of the different ancient coins known to us amount only to about

80,000, though he owns that the calculation cannot be esteemed accurate.

(To be continued.)

THE CHEMIST.

CHEMICAL ATTRACTION OR AFFINITY.

(Continued from page 333.)

1. Put into a crucible placed into a coal fire, equal parts by weight of sulphur and mercury; stir the two substances together for a few minutes, and when the sulphur is melted, pour the contents out on a marble slab, or a piece of glass previously warmed and greased.

The substance obtained by this means is *sulphuret of mercury*, in which the mercury and sulphur are united by virtue of chemical affinity; for the compound has neither the colour, the splendour, the inflammability, the volatility, nor the specific gravity of either of its constituent parts; nor can the sulphur and mercury be separated by mechanical means; they are therefore chemically united.

2. If we melt together two very malleable and ductile metals, for instance, tin and iron, in equal quantities, the compound produced will have totally lost the properties which its constituent parts possessed before their union, for the alloy formed will be a brittle metal which may easily be broken by the blow of a hammer.

3. Put two or three teaspoonfuls of an aqueous infusion of red cabbage or syrup of violets, into a wine glass of water, mix it well, and put half the mixture into another glass. By adding a few drops of sulphuric acid to one of the glasses and stirring it, the blue will be changed to a crimson; and by adding an alkali; for instance, potash, to the other glass, the blue fluid will be changed into a green.

If we drop carefully down the sides of the glass into the green obtained in this experiment, a few drops of sulphuric acid, crimson will be perceived at the bottom, purple in the middle, and green at the top. On adding a little alkali to the other glass, containing the crimson, these colours will appear in an inverted order.

4. When equal parts of muriate of ammonia and slacked lime, both substances destitute of adour, are intimately blended in a stone mortar, a very pungent gas (ammonia) becomes evolved.

5. Water impregnated with ammonia and concentrated muriatic acid, both fluids of a strong odour, when mixed together in proper proportions, instantly lose their odour, and form a fluid void of smell (muriate of ammonia.)

6. Into a saturatad solution of muriate of lime, let fall gradually concentrated sulphuric acid, a quantity of pungent vapour will become disengaged, (muriatic acid, gas), and from the two fluids will thus be produced an almost solid compound, called sulphurate of lime.

7. Let equal parts of fresh crystallized acetat of lead and acidulous sulphate of alumine and potash, be rubbed together intimately in a stone mortar, the same mixture will soon become soft and lastly fluid.

A like effect is produced by treating in a similar manner equal parts of crystalized nitrate of ammonia and sulphate of soda.

A solid alloy of mercury and bismuth, and another composed of lead and mercury, on being triturated together, instantly becomes fluid.

It is obvious from this, that when chemical combination takes place, the compound which is formed does not possess properties merely intermediate between those of its component parts, but has acquired others more or less new. This however, does not hold good in all cases. There are various combinations in which the properties of bodies are only slightly altered.

Observation has shown that affinity of composition offers certain invariable phenomena, which being founded on a great number of facts are regarded by chemists as laws, and may be reduced under the following heads.—

Law 1.—Chemical affinity can exert its action between a number of bodies, simple or compound, and unite them chemically into one whole.

2. The efficacy of chemical affinity is in an inverse ratio to that of attraction of aggregation.

3. The agency of chemical affinity is influenced by temperature; its action is either accellerated, retarded, prevented, or rendered efficacious.

4. Chemical affinity is accompanied by a change of temperature at the instant of its action.

5. The agency of chemical affinity existing between two or more bodies may be dormant, until it is called into action by the interposition of another body which frequently exerts no energy upon any of them in a separate state.

6. The ratio of the energy of chemical affinity acting between various bodies, is different in different substances.

7. The agency of chemical affinity is either limited, or unlimited in certain bodies; in other words, chemical affinity is capable of uniting bodies in definite, or in indefinite proportions.

8. The energy of the chemical affinity of different bodies is modified in proportion to the ponderable qualities of the bodies placed within the sphere of action.

Such are the leading laws which regulate chemical affinity; they may be demonstrated by experiments.

1. Chemical affinity can exert its action between a number of bodies, simple or compound, and unite them chemically into one whole:—

There are an infinite variety of compounds, consisting of three, four, five or more simple substances in nature; and art can also effect combinations in which there are many simple bodies chemically united into one whole.

It frequently happens that various separate bodies presented to each other in a third, unite and form a single mass, which possesses all the characters of an homogeneous compound, and which retains these characters till its composition has been altered by chemical means.

A considerable number of triple salts are known, which consist of three different substances; for instance, the common alum of commerce consists of sulphuric acid united to alumine and potash or soda. The salt formerly called microcosmic salt, or phosphoric acid united to soda and ammonia, &c. When the oxigenated muriate of mercury is precipitated by the precise quantity of carbonate of soda which is requisite to effect its decomposition, the precipitate obtained contains muriatic acid, carbonic acid, and oxide of mercury in excess.

It is a well known fact that two, three, or more metals may be fused together so as to produce compounds whose properties are widely different from those of the constituent parts.

Melt together in an iron ladle or crucible, eight parts of bismuth, five of lead, and three of tin, the fusibilty of the metals will thus be altered, for the alloy melts at 212° fahr. A spoon or any other utensil formed of this compound will therefore melt in water kept boiling.

If in a similar manner any alloy be made of lead, tin, bismuth, and mercury, their proportions being two, three, five, and one, the compound produced melts at a heat even less than that of boiling water.

A composition of lead, zinc, and bismuth, in equal parts, may be kept in fusion upon paper over a lamp.

2. The efficacy of chemical affinity is in an inverse ratio to that of corpuscular attraction:—

The cohesion of the particles of a body is owing to the mutual affinity existing between them. It is this force which must be overcome by the action of the substance which has a tendency to combine with those particles chemically. Chemical affinity therefore does not become *stronger* as the affinity of aggregation becomes *weaker*, it becomes only *more efficacious*; the absolute powers remain the same; the effect produced by that agency *increases*, because the resistance opposed to it *decreases*.

(To be continued.)

MISCELLANEA.

Discovery of a supposed Roman Villa.—Considerable excavations having been lately made in a field called Cheshuntfield, nearly oposite to Mr. Woodward's house, on the Maldon road from Colchester, and about a quarter of a mile from the Leather Bottle, in Laxden parish, the foundations of a building, supposed to be a Roman Villa, have been laid bare: the extent is of such magnitude that it is questioned if the remains of any Roman Villa in this kingdom are of equal extent. A small portion only has been traced at present. Three sides of a square have been discovered, with a double wall of considerable thickness, leaving a clear space between them of fourteen feet. The measurement of the exterior wall in length is 285 feet, and of the inner 265. Numerous coins have been thrown up during the excavations; amongst these a "Titus," 2d., brass; reverse, "Judea Capta." "Helena," 3d, brass; and a "Caransius," 3d., brass, in fine preservation, struck upon a treaty made by that usurper with Diocletianus and Maximinus. The fragments thrown up are mostly of Roman antiquity—broken urns, bricks, tiles, boars' teeth, bones of animals, mortar, &c. It appears from a hasty survey, that this superstructure has been removed for purposes that may be hereafter explained. The ground will be ploughed up in about a fortnight for the purpose of cultivation. To antiquarians this discovery offers a very extensive field for investigation.—*Ipswich Paper.*

Leech Catching.—In some parts of England, more particularly in the fenny districts of Cambridgeshire and Lincolnshire, the trade in leeches form a valuable branch of business. The manner in which the latter are taken is thus:—Two or three

persons, furnished with long poles, enter the marshes with their shoes and stockings off, and continue beating the weeds and rushes for some time. The leeches being disturbed by this proceeding are aroused from their wonted lethargy, and impelled by hunger, the effect of long abstinence, seize with avidity the first animal object they meet with. The feet and ankles of the leech-catchers being exposed to them, the same are freely fastened upon by the above aquatic phlebotomists, and are thence removed and deposited in a basket carried for the purpose of receiving them. When taken home, they are washed in a weak solution of salt and water, and when purified, are carefully packed in wet linen cloths, and in this manner are despatched to the different leech-merchants and the various medical establishments throughout the country. So lucrative was the above trade some time since, that a poor man named Smith, living at Baddesley, in Hampshire, in the course of a few years had amassed the sum of 500*l.* and upwards, as was discovered at his death.—*Evening Paper.*

Quantity of gas consumed in London.—Gas-pipes of half-an-inch in diameter supply a light equal to twenty candles, one inch, 100, two inches, 450, three inches, 1000. The gas which lights London is made by companies, who consume 50,000 tons of coal per annum, which make 400 millions of cubic feet of gas, lighting 62,000 in-door, and 7500 street-lamps. Various establishments make one-eighth more.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, September 28, C. Johnson, Esq., on the Vegitation of the Waters. Friday, September 30, J. H. Parry, Esq., on the Oratory of the French Revolution. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, Sept. 29, Mr. James Smith, on Friendly Societies, and the prevention of indigence. At half-past eight.

QUERIES.

Do the organ-builders' use parchment inside the wind-chest, if so, for what purpose. Also what kind of wood would be best for the keys?
T. L. T.

Sir,—Being about to construct a seraphine, I shall be extremely obliged to any of your correspondents who will furnish me with working directions, with drawings, &c. of the arrangements for working the bellows, and also the necessary scale for the reeds, with the mode of producing piano and forte; the best material for the reeds or tongues and so on—either through the medium of your journal, or by means of a private communication, to be addressed (by your leave) to your care till called for. Is there any work published on the subject of seraphines or organs, if so, who is the publisher and what is the price? Which of the smaller organ stops could be advantageously combined with a seraphine? W. H.

"G. S. Jun." will particularly oblige "S. E," if he will, in addition to what he has already given in a very lucid manner, with regard to the mechanism of organs, favour him with the usual mechanical arrangement for causing the pedals to act upon the keys; also for connecting two rows?

The price of a small electrical machine at the makers, also where I can obtain a good and cheap work upon electricity and electrotyping. E.

Sir,—I feel obliged to your correspondent for the information afforded, and should be farther obliged if he would be so kind to inform me, the earliest opportunity, where I can obtain "Rees' Cyclopædia," and the probable price. And if there are any libraries where any of the works alluded to can be perused or obtained for a short time. J. W.

Is glass ground or prepared in any way before painting. How the colours are mixed for doing so? G. D.

A description of the Caisson which has lately been erected on the Goodwin Sands? K. M.

Where can I procure calcined water for soldering iron; I have tried all the chemists in the town, but cannot procure any? Of what materials are crucibles made, and what is the cause of there breaking in the fire? D. M.

Have any of your correspondents an alarum to part with of cheap and simple construction?
L. S.

Sir,—Can you or any of your correspondents inform me what signal is generally made use of in a diving-bell, in order to let the men in charge of it know when it is to be hauled up. That employed by Major Paisley, and Dr. Payerne, during their experiments at Spithead, on the 2nd instant, must have been a very imperfect one, as they were hauled up no less than three times by the signal being misunderstood? There is an apparatus at the Polytechnic Institution, used for predicting changes in the weather, and which I am told is a very accurate one, consisting of a light white substance floating in a transparent liquid. Can you inform me what the substance and liquid are? The former rises or sinks, to indicate change. X. Y. Z.

The method of forming the teeth of wheels invented by professor Willis? 2. Description of Smees Battery? 3. We have some venetian blinds which where to be varnished with the copal varnish, but suspecting that another varnish of inferior quality has been put, I wish to know the method of distinguishing the former? 4. Mixture used in making earthenware? P. H.

ANSWERS TO QUERIES.

"X. Y. Z." I imagine that the instrument called a "turn bench," used by clockmakers' is that referred to. A continuous rotary motion is obtained by means of a small fly-wheel, with a winch or handle turned by the left hand, and placed on a standard behind the tool, being connected with the pulley by means of a cat-gut line. Watch or clock-makers have little use for a lathe with eccentric chuck. A lathe about twelve inch bed, and three inch centre, would cost from 7*l.* to 10*l.*; an eccentric chuck about 7*l.* new. If "X. Y. Z." inquires at the tool shops, he will get more precise information.

"J. C." In order to render gold malleable it is alloyed in various proportions with silver or copper, the amount varying with the object for which it is required, and also with the practice of various artizans.

"X. Y. Z." There is no other way of platenizing silver, than by means of galvanism, as the metal is required to adhere to the surface in the form of a finely devided powder.

"J. C." will find an engraving and description of the compensation balance, in Vol. 7, page 90, of your valuable miscellany. It is not true that watches stop while crossing the line, except from neglect or accident. The line (and also the equator), is merely an imaginery belt round the globe, and has no existence in reality. It is of use merely to determine certain problems of geography. Chronometers have been known to stop from the intense cold in the polar regions, and if placed in heat sufficiently powerful to violently expand or oxidize the machinery, would doubtless stop; but such a degree of heat does not exist naturally in the atmosphere of any place.

W. H.

"W. C. Jun." The sealing-wax poured hot into a tin raised at the edges, or, dissolved in alcohol and spread, will answer the same purpose as being poured in a fluid state on the board.

"Ignoramus" may make a composition which will ignite by friction, in the following manner:—Reduce separately to powder the following ingredients in the proportions mentioned, and mix them with a wooden spatula on a sheet of writing-paper,

Chlorate of potass	45 parts
Sulphur	20
White sugar	12

then make a thick mucilage of gum arabic, and add thereto several pieces of phosphorus, (the exact quantity is best determined by experiment), put them into a concave bottomed gallipot, expose it to a heat sufficient to melt the phosphorus, and mix them as intimately as possible—pour the compound on a hot marble stone, and work it up with a palette knife into a stiff paste with the chlorate, &c., when it may be formed into any shape you may think proper.

"A. W. M" Tracing paper may be made by rubbing common tissue paper with poppy oil or Canada balsam; which, when dry, being laid over a drawing, it appears through the transparent paper, consequently can be copied.

"H. J. Budd." Saturated solutions of both muriate of ammonia, and sulphate of copper, should be used with the electrotype apparatus. I have always succeeded with water acidulated by sulphuric or nitric acid for the porous cell.

"J. C." A compensation balance is a wheel so contrived as to expand or contract, according to the temperature, and thus enabling the chronometer to keep exactly the same rate of going in all climates. The following is a description of Arnold's compensation balance:—

The rim of this balance, instead of being composed of a solid ring of steel, as in the common balance wheel, consists of three arcs, each composed of two stripes of different metals, one of them steel, the other an alloy of zinc and silver, or of brass. The adjustment of these metals is such that expansibility of one shall counteract the expansibility of the other, and a perfect uniformity of size in the balance; and consequently, in the rate of going of the instrument, be preserved in all degrees of heat and cold. The use of the weights is, that the momentum shall reside in the rim of the wheel.

Receipt for blue writing ink:—oxalic acid, ½ an ounce; prussian blue, ¼ of an ounce; water, sixteen ounces. Pulverise the oxalic acid, and prussian blue in a marble mortar, pour the water on it at intervals, and rub them together till perperfectly dissolved. R. M. Ordish.

TO CORRESPONDENTS.

A New Subscriber *will find the subject he refers to, fully treated on in several of our back Numbers, and from which we have no doubt he would require the derived information.*

J. M. W. *is referred to a series of papers, "on the mode of preparing steel for tools, &c," communicated by our respected correspondent, "an Amateur Mechanic," commencing with the first number this year. If J. M. W. will peruse these attentively, we are quite sure that he will not regret having taken the trouble of doing so.*

W. Jenkins *wishes to know how echoes are produced: we refer him to No. 33, vol. 4, where he will find it explained.*

London: Printed at "The City Press," 3, Long Lane, Aldersgate, by D. A. Dowsey to whom Books for Review and all communications for the Editor must be addressed, postage paid; published every Saturday, by G. Berger, Holywell Street, Strand, and may be had of all Booksellers and Newsmen in Town and Country.

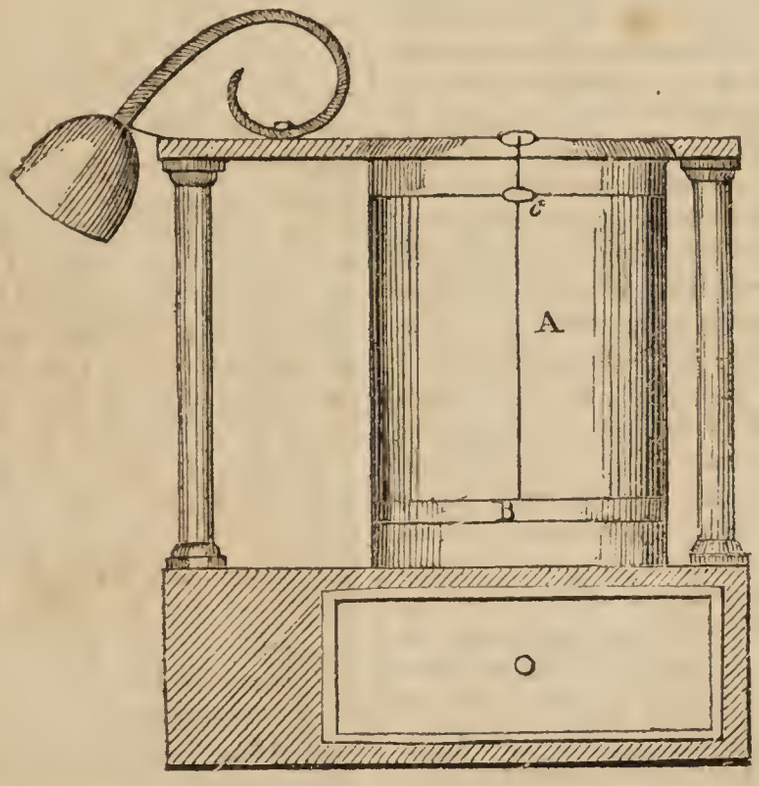
THE PENNY MECHANIC

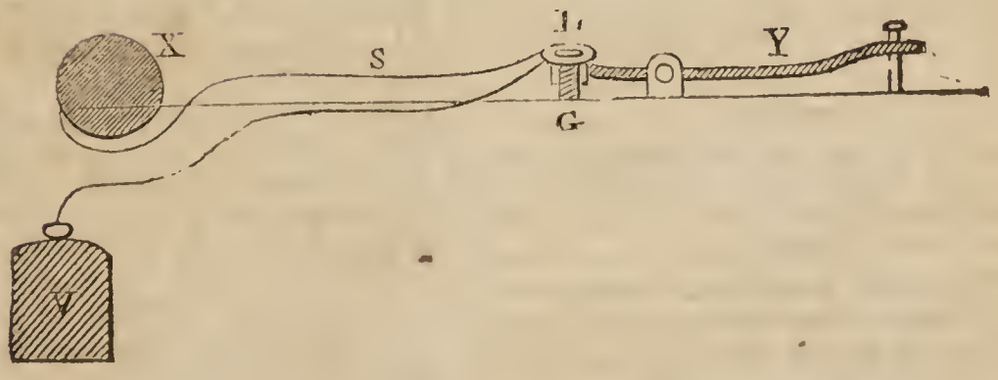
AND CHEMIST.

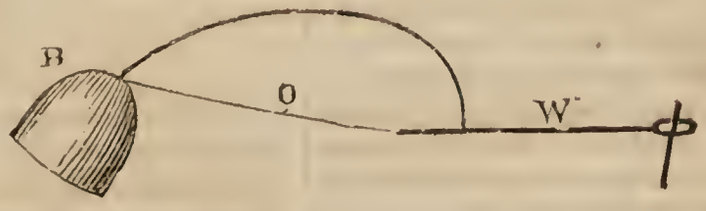
A MAGAZINE OF THE ARTS AND SCIENCES.

No. 103, THIRD SERIES. | SATURDAY, OCT. 1, 1842. | No. 351, OLD SERIES.

CHEAP AND SIMPLE ALARUM.







Vol. VIII.—No. 44.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

CHEAP AND SIMPLE ALARUM.

(See Engravings, front page)

I think I saw in a late Number of your most excellent little work, an inquiry for a cheap and simple alarum. The following is a contrivance of mine, and I think it is the simplest I have ever seen. A, is a wooden cylinder bored as smooth and true as possible (brass or tin would be better); B is a piston with a piston rod, which slide down as the sand runs out; *c* is a guide for the piston rod to move in. This guide takes out along with the piston in order that the sand may be put in. The piston rod is graduated for the number of hours which will be according to the size of the cylinder. The additional little sketch shows two modes of setting off the alarum. In the first, B is the bell, which has a string, *o*, attached to it; to the string is fastened a wire, W, with a loop at the end of it; this loop is slipped over the piston rod, and of course the moment the piston rod sinks below the loop, off the bell goes. The other sketch shows a plan for setting off the alarum when a weight is employed to ring the bell. X is a roller round which the cord is wound; S is the string with the loop, L. The loop in this case instead of being put over the top of the piston rod, is put on to a little wire peg, G; and the piston rod has a little button or catch on the top of it, so that when it reaches the lever, V, it raises the other end and twitches off the loop, L, and down goes the weight, arousing us from the arms of morphens, and making us wonder what on earth all that clatter is about. I have another water alarum, which I will send at a future time if agreeable, which is quite as simple as this, but of course larger.

Yours truly,

ALARUM.

THE SURFACE LATHE.

To the Editor of the Penny Mechanic and Chemist.

SIR,—The very handsome manner in which you open your columns for public opinion, must merit the attention of all who have generosity to teach, and the humility to be taught (for surely there are none perfect), your very clever correspondent "an Amateur Mechanic" in a former Number, calls the attention of men of science to a very important subject in the surface lathe. I would first observe where he says, that the opinions of practical men are much divided on the subject of speed that ought to be given to cast iron in order to obtain the greatest effect from the tool. For my own part, I do not think that a maximum velocity can be established from the fact of the difference of the malleability in cast iron. Even with one description of iron, moulded by two different men, I have found a marked difference in the working it; but where he says that regular motion in surface turning is not only prejudicial in relation to its effects, but also involves a great waste of time, no one can dispute indeed, I think, the suggestion is quite an original one.

I would propose that to overcome the difficulty of the workman (having to stop the lathe to slacken his speed as he extends onwards in his work, for in surface turning it is always the most convenient to begin at the centre), if we have a conical pulley keyed on the back motion spindle, as long and as large as the space will admit; say the lathe is worked by a band, let there be as many grooves cut in the pulley as can possibly be got in; the next thing will be to have an over-head motion, with two loose pulleys running on a bar, and a weight, the cord of which must pass over another sheath, and fasten to the end of the slide, by this means the band of the lathe will be kept tight, and thus are there no difficulties in the way.

There is one other contrivance yet wanted in the shape of a lever to extend from a convenient spot for the workman, longitudinally with the lathe to the hand; let there be as many notches cut in it or otherwise as there are grooves in the pulley; and let these notches slip on to a stud or a piece of thin iron with its edge upwards, at the other end of the lever, let it be turned at right angles, and as a fork with as narrow a space as possible for the band to work between, then say the smallest groove on the conical pulley is suited to the speed required for the centre of the plate about to be turned, and as you advance draw the lever forward one notch or tooth, and thus the band is drawn on to another grove and a slower motion is obtained, and so on to the edge of the plate, *c*, as it may be required.

Although a self-acting motion on this principle might be preferable, yet it is one that would be attended with much more expense and trouble.

I remain, yours &c.,

G. LODGE.

Heat.—Extreme cold produces the same perception on the skin as great heat. When mercury is frozen at 40° below Zero, the sensation of the skin is the same as that of touching red-hot iron.

EXTRAORDINARY MECHANICAL INVENTION.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I beg to call the attention of your readers to the following descriptive paragraph, taken from a provincial paper, of a very important and valuable mechanical invention.

I have only to add, that I shall esteem it a particular favour, if any party will oblige me, through the pages of the Penny Mechanic, with farther and more detailed particulars of this novel machine; which, if its powers be correctly stated, is obviously calculated to confer a very essential benefit on all who are interested in constructive mechanism; a pursuit in which few are more enthusiastic than

Your obedient Servant,

An Amateur Mechanic.

"*Extraordinary Mechanical Invention.*—Although, at the late meeting of the British Association in Manchester, there were many very interesting specimens of mechanism exhibited, there was one, nevertheless, which threw all others completely in the shade, when considered either as to the novelty of the invention, or its evident practical applicability to the every day concerns of life, and may with truth be said to be the "lion of the exhibition,"—viz., a machine for working or forging of iron, steel, &c. This truly surprising machine is quite portable, occupying only a space between three and four feet; and cannot be deemed other, even by the most critical judges, than one as purely original in principle, as well as practical in its application, as much so as perhaps was the splendid invention of the fluted roller of Arkwright, by which the art and perfection of drawing the fibrous substances became known; or that other still more splendid discovery of Watt—the condensing of steam in a separate vessel, by which the power of the steam-engine of that day may be said to have been doubled. But now for some explanation of the machine, and its probable general application. It is, then, as has been before said, very portable, not requiring more space than three or four feet, and may be worked by steam or water-power, and when moved by the former, as was the case at the exhibition, made 650 blows or impressions per minute; but from their very quick succession, and the work being effected by an eccentric, pressing down, not striking the hammer or swage, not the least noise was heard. There are five or six sets of what may be called anvils or swages in the machine, each varying in size. The speed and correctness with which the machine completes it work is perfectly astonishing, and must be seen in order that its capabilities in this respect may be duly appreciated: for instance, when it was put into motion for the purpose of producing what is known as a roller with a coupling square upon it, and which had to be afterwards turned and fluted, the thing was accomplished in fifty seconds, of course at one heat, to the astonishment of the bystanders; but what appeared as the most extraordinary part of the affair was, that the coupling square was produced, direct from the machine, so mathematically correct, that no labour can make it more so! The machine will perform the labour of three men and their assistants or strikers; and not only so, but complete its work in a superior manner to that executed by manual labour. For engineers, machine-makers, smiths in general, file-makers, bolt and screw-makers, or for any description of work, parallel or taper, it is most specially adapted; and for what is technically known as reducing, it cannot possibly have a successful competitor; in proof of which, it may be stated, that a piece of round iron, $1\frac{3}{4}$ inches in diameter, was reduced to a square of $\frac{3}{8}$ inch, two feet five inches long, at one heat. The merit of this invention, it is said, belongs to a gentleman of Bolton, of the name of Ryder."

HISTORY OF MEDALS.

(Continued from page 341.)

The most difficult and the most important thing in the whole science of medals, is the method of distinguishing the true from the counterfeit. The value put upon ancient coins made the forgery of them almost coeval with the science itself; and as no laws inflict a punishment upon such forgers, men of great genius and abilities have undertaken the trade: but whether to the real detriment of the science or not, is a matter of some doubt; for if only exact copies of genuine medals are sold for the originals, the imposition may be deemed trifling: but the case must be accounted very different, if people take it upon them to forge medals which never existed. At first the forgeries were extremely gross; and medals were forged of Priam, of Aristotle, Artemisia, Hannibal, and most of the other illustrous personages of antiquity. Most of these were done in such a manner, that the fraud could easily be discovered; but others have imposed even upon very learned men. Mr. Pin-

kerton mentions a remarkable medal of the emperor Heraclius, representing him in a chariot on the reverse, with Greek and Latin inscriptions, which Joseph Scaliger and Lipsius imagined to have been struck in his own time, but which was certainly issued in Italy in the 15th century. "Other learned men (says our author) have been strangely misled, when speaking of coins; for to be learned in one subject excludes not gross ignorance in others. Budæus, de Asse, quotes a denarius of Cicero, M. TULL. Erasmus, in one of his epistles, tells us with great gravity, that the gold coin of Brutus struck in Thrace, ΚΟΣΩΝ, bears the patriarch Noah coming out of the ark with his two sons, and takes the Roman eagle for the dove with the olive branch. Winkelman, in his letters informs us, that the small brass piece with the Virgil's head, reverse EPO, is undoubtedly ancient Roman; and adds, that no knowledge of coins can be had out of Rome: but Winkelman, so conversant in statues, knew nothing of coins. It is from other artists and other productions that any danger of deceit arises. And there is no wonder that even the skilful are misled by such artists as have used this trade; for among them appear the names of Victor Gambello, Giovani del Cavino, called the PADUAN, and his son Alessandro Bassiano, likewise of Padua, Benvenuto Cellini Alessandro Greco, Leo Aretino, Jacobo da Frezzo, Federigo Bonzagna, and Giovani Jacopo, his brother; Sebastiano Plumbo, Valerio de Vizenza, Gorlæus, a German, Carteron of Holland, and others, all or most of them of the 16th century; and Cavino the Paduan, who is the most famous, lived in the middle of that century. The forgeries of Cavino are held in no little esteem, being of wonderful execution. His and those of Carteron are the most numerous, many of the artists here mentioned not having forged above two or three coins. Later forgers were Dervieu of Florence who confined himself to medallions, and Cogornier who gave coins of the thirty tyrants in small brass. The chief part of the forgeries of Greek medals which have come to my knowledge are the first mentioned, and a very gross kind, representing persons who could never appear upon coin, such as Priam, Æneas, Plato, Alcibiades, Artamisia, and others. The real Greek coins were very little known or valued till the works of Goltzius appeared, which were happily posterior to the æra of the grand forgers. Why later forgers have seldom thought of counterfeiting them cannot be easily accounted for, if it is not owing to the masterly workmanship of the originals, which set all imitation at defiance. Forgeries, however, of most ancient coins may be met with, and of the Greek among the rest.

"The forgeries are more conspicuous among the Roman medals than any other kind of coin; but we are not to look upon all these as works of modern artists. On the contrary, we are assured that many of them were fabricated in the times of the Romans themselves, some of them being even held in more estimation than the genuine coins themselves, on account of their being plated, and otherwise executed in a manner to which foreign forgers could never attain. Even the ancients held some of these counterfeits in such estimation, that Pliny informs us there were frequently many true denarii given for one false one."—Caracalla is said to have coined money of copper and lead plated with silver; and plated coins, the work of ancient forgers, occur of many Greek cities and princes; nay, there are even forgeries of barbaric coins. "Some Roman coins are found of iron or lead plated with brass, perhaps trials of the skill of the forger. Iron is the most common; but one decursio of Nero is known of lead plated with copper. Neumann justly observes, that no historic faith can be put in plated coins, and that most faulty reverses, &c., arise from plated coins not being noticed as such. Even of the Roman consular coins not very many have ever been forged. The celebrated silver denarius of Brutus, with the cap of liberty and two daggers, is the chief instance of a consular coin of which a counterfeit is known. But it is easily rejected by this mark: in the true coin the cap of liberty is below the guard or hilt of the daggers; in the false, the top of it rises above that hilt."

The imperial series of medals is the grand object of modern medallic forgeries; and the deception was extended to the most eminent writers upon the subject. The counterfeits are by Mr. Pinkerton divided into six classes.

(To be continued.)

THE CHEMIST.

CHEMICAL ATTRACTION OR AFFINITY.

(Continued from page 342.)

IT is from this law that it was formerly inferred that some or at least one of the bodies should be in a state of fluidity. This however is by no means necessary.

It is in general true, that the weaker the attraction of aggregation is, the more easily chemical affinity takes place, as may be evinced by means of the following experiments:—

Let any quantity of dry carbonate of soda and tartareous acid be mingled together, and put the mixture into a wine-glass, no chemical change will be produced; but if water be added, or either of the salts be previously dissolved, a violent effervescence ensues, and a chemical union is obtained.

The water added, is of use merely to overcome the resistance which arises from the cohesion of the particles of the salts intended to be brought into the sphere of action, or to increase their mutual contact.

If we let fall a crystal or a lump of fluor spar (fluate of lime) into concentrated sulphuric acid, no sensible action will take place, both the sulphuric acid and the fluate of lime remain unaltered; but if the former be reduced to powder, and then brought into contact with the acid, a considerable action instantly takes place, the sulphuric acid unites to one of the constituent parts of the fluor spar, namely, to the lime, and its other constituent part, the fluoric acid becomes disengaged in the state of white vapour, or fluoric acid gas.

If crystallized sulphate of alumine, or sulphate of soda, and acetate of lead are brought into contact with each other, the individuality of these bodies will not be destroyed, that is to say, no chemical change will take place; but if they be intimately rubbed together in a mortar, the two solids will act upon each other and form a fluid.

It is obvious therefore that in order to facilitate chemical affinity, the attraction of aggregation must be broken; the bodies intended to be chemically united, must not be presented to each other in their mass of contact, but mechanically divided, or reduced to the smallest moleculæ possible: hence liquids combine with more facility than solids, or even than a solid and a liquid, and in like manner vapours combine with rapidity and ease.

3. The agency of chemical affinity is influenced by temperature. Its action is either accelerated, retarded, prevented, or rendered efficacious:—

If we expose phosphorus in an open vessel to the action of the atmosphere, a chemical union will take place between the phosphorus and one of the constituent parts of the atmosphere, namely, the oxygen gas; the phosphorus will gradually (but very slowly) disappear, and become converted into a fluid called phosphorous acid.

But if we heat the vessel containing the phosphorus, the latter will take fire, and become converted into a yellowish white substance, which in a short time is changed into an acid analogous to the former.

If equal quantities of muriate of ammonia and carbonate of magnesia are mixed with six or eight parts of water, and suffered to stand for some time exposed to the ordinary temperature of the atmosphere, a mutual decomposition of the two salts will take place. For if the mixture, and the fluid which passes, are left to evaporate spontaneously, muriate of magnesia and carbonate of ammonia will be obtained. On the contrary.

If equal quantities of muriate of magnesia and carconate of ammonia be exposed to a temperature of 200° in about four parts of water, the products obtained are, muriate of ammonia and carbonate of magnesia.

If muriate of soda and sulphate of magnesia be mixed together in any proportion, and exposed to a temperature below *zero*, they decompose each other, and muriate of magnesia and sulphate of soda are formed, but no decomposition takes place at a temperature above 30°.

Muriate of soda and acidulous sulphate of alumine and potash, exhibit precisely the same phenomena.

If ardent spirit and a solution of salt in water be mixed together, the compound formed is a real chemical union; but if we carefully heat the fluid, the caloric applied will be divided between the three ingredients according to their respective affinities; the union will be broken, for the ardent spirit will first become volatilized, and the union of the salt and water remain unaltered. On increasing the temperature, the water will escape in the form of vapour, and the salt will be left behind.

There are numerous cases in which an increase of temperature is essentially necessary to determine bodies to unite. If mercury be exposed to oxygen gas at the common temperature of the atmosphere, the corpuscular attraction subsisting between its particles is sufficient to prevent combination. But if the mercury be heated to a certain degree, the force which kept its particles united will become annihilated, and it then combines with the oxygen which is present.

Again, if the oxide of mercury thus formed, be exposed to a higher degree of temperature, the union is demolished, and the quicksilver reappears in its metallic state.

Hence it is obvious that the action of caloric favours the union of the oxygen and mercury, in consequence of the diminution of the mutual affinity of the parts; but at length, by augmenting this difference, it again breaks the union, or renders the combination impossible.

That increased temperature augments the power of chemical union, the solutions of salt and water afford instances of.

A larger quantity of salt is soluble in a given quantity of water at a high, than at a low temperature, and this larger quantity of salt is again separated by cooling.

4. Chemical affinity is accompanied by a change of temperature at the instant of its action:—

When equal parts of concentrated sulphuric acid and ardent spirit are mingled together, the mixture in a few minutes becomes so hot as to render the vessel insupportable to the hands.

If four parts of sulphuric acid of commerce, and one part, by weight, of water, be mixed together, each at the temperature of 50°, the mixture immediately acquires a temperature of about 300°.

All the dense acids, ammonia, and ardent spirit, when mixed with water, have the property of raising its temperature remarkably: and the same is the case when alkalis are introduced into concentrated acids. On the contrary, in many instances cold is produced:—

(To be continued).

REVIEW.

The Hand-book of turning, containing instructions in concentric, elliptic, and eccentric turning; also various plates of chucks, tools, and instruments, and directions for using the eccentric-cutter, drill, vertical-cutter, and circular-rest; with patterns, and instructions for working them. 12mo. cloth, 1842, pp. 143. Saunders and Otley.

A PRACTICAL treatise on this interesting and popular art, has long been a desideratum in British literature; and when the work before us was announced, we had hoped, considering the tact and respectability of the publishers, that this reproach on our national enterprise would be effectually removed. In this expectation we candidly confess we are, to a certain extent, disappointed; but it must be conceded that in estimating the value of a book which literally stands alone, a very liberal allowance should be made; and for this plain reason, with the exception of two or three tracts on distinct branches of the art, we have not any one separate treatise in English on turning.

Consequently when we commenced the perusal of this hand-book, we felt bound in justice, to treat with all possible leniency, the production of an author, the subject of whose study is not only difficult and intricate in itself, but is rendered still more so from the fact of being 'unbroken ground.'

It would be scarcely possible, we apprehend, to name any art or science which has not been ably discussed and fully illustrated by the research of men who have devoted years of patient and assiduous labour to the particular object of their study; hence all the land marks (so to speak), are clearly indicated, extraneous matter removed, and what is equally important, the data and formulæ on which scientific investigation is based, are distinctly defined; thus the task of literary composition is necessarily rendered much easier, but as we have already observed, no such aids are here available; which is the more remarkable, since the art of turning, whether considered as a healthful and elegant amusement, or as a mechanical occupation, depending on the known laws of geometry, possesses unquestionable claims on the attention of the theorist as well as of the practical mechanic. Looking at the extraordinary precision with which the lathe performs its work, the endless variety of beautiful designs which result from a combination of cycloidal, and the eccentric or elliptic movement; it is somewhat singular that a machine, apparently simple in its construction, but at the same time susceptible of the most rigid mathematical accuracy, should have been thus strangely neglected.

But the lathe, as a producing engine, has far higher claims on our attention than the mere ornamental trifles which originate as it were in the exuberance of fancy from its revolving mandril, since it is undeniable that the chronometer, the steam-engine, the printing press, and indeed almost every other machine, owe to the truth and fidelity of its movements, a very large proportion of the accuracy and correct workmanship, which peculiarly distinguish the mechanical productions of the present century.

To describe the construction of the lathe and its application in any or all of its varied modifications, and in such a manner as to be beneficially available to the practical man, demands a natural aptitude united with acquirements, such as are

seldom found in any one individual. Few educated men, especially if attached to analytical science, care to trouble themselves with technical details, or the operations of laborious handicraft, which, trivial as they seem to the uninitiated, yet are absolutely and essentially necessary; because without a competent knowledge of practical mechanics, no correct estimate, we are quite sure, can be formed of the probable working value of many ingenious contrivances, on which the character of the modern lathe mainly depends. That the author of the hand-book of turning is not a practical mechanic, is perhaps rather a subject for congratulation to himself, personally; be this as it may, the fact is clearly indicated in every page of his book, and this constitutes, in our opinion, its chief defect. That we have not arrived at a hasty or erroneous conclusion, is manifest from the number of subjects (according to the prefixed table, no less than 120) discussed within the narrow, and as we imagine, disproportioned limits of something less than 150 pages. If farther proof be sought, we refer our readers to page 58, where in describing the slide-rest, a micrometer head affixed to the main screw, is designated "*a small brass wheel divided into numbers;*" the square end of the same screw is called "*a square head;*" the clamping screw of the rest is termed "*a nut;*" these and such like misnomers, which are utterly incomprehensible to a working man; run through the book, and by an inaccountable mistake a male screw is, in almost every instance, converted into a nut, or in other words, a female screw.

It may perhaps appear almost hypercritical to point out errors and omissions in a work whose limited extent forbids anything beyond a very slight sketch; yet with a view to enable the author to correct the same in a second edition, we observe that the circular-rest, page 77, stated to have been "lately invented," will be found fully described in Hamelin-Bergerons Manuel du Tourneur, 4to. tom. ii. p. 124; and as this elaborate work was published nearly thirty years ago, the circular-rest cannot be said to be a late invention. Again, the most important fact in relation to ball-turning, for which this description of rest is peculiarly calculated, is entirely omitted; we allude to the necessity of so arranging the rest, that its centre of rotation shall be exactly perpendicular to the prolonged axis of the lathe-mandril. We farther beg to remind the author of this hand-book, that we are fully aware of the sources from whence he has drawn the larger portion of his work; if instead of resorting to obvious and familiar authorities, he had incorporated the more useful parts of the foreign treatises on the art, and carefully recorded the results of his own observation, we should not have had occasion to advert to such palpable omissions, as the universal chuck, the compound eccentric, the straight-line, the geometric, the triangular bar-lathe, the self-acting slide-rest, and other matters, some of which as more immediately relating to ornamental turning, we place out of the enquiry. We repeat, had the author adopted some such plan as that we have suggested, we should have been in a position to yield him unqualified commendation. To the practical mechanic, this hand-book will prove, we fear, of little value or interest; but to the amateur who merely wishes for a brief and cursory analysis of some branches of this fascinating art, this very prettily illustrated book will be found an agreeable, if not in the strictest sense of the word, an useful manuel. To this class of our readers, we sincerely and honestly recommend it, feeling assured that one single sentence at the conclusion, properly applied, is well worth the cost of the book; it is this—"whatever is worth learning at all; is worth learning well."

The King of Prussia.—It may not be generally known that the King of Prussia has had a gold medal struck in his own dominions for the purpose of presentation to the most distinguished artists who may come under his especial approval. It is of solid gold, weighing twenty dwt., and is very tasteful in its arrangement, On the obverse, in a concave centre, is an excellent likeness in relief of his Majesty, which is surrounded by a broad border in dull relief, bearing emblematical devices of the arts. On the reverse appears the *facade* of an elegant Grecian structure, with Apollo in his car rising above the centre. This beautiful work bears the name of "Pfeuffer" on the reverse, and "Jackman" on the obverse. One of these has been bestowed, through the hands of Chevalier Bunsen, on Mr. Benjamin Wyon, in testimony of his Majesty's approval of the gold medal struck in commemoration of his visit to England and sponsorship of the Prince of Wales. This is the second mark of royal approbation received by Mr. Wyon from the Prussian dominions.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, October 5, C. Johnson, Esq., on the Vegitation of the Waters. Friday, October 7, J. H. Pepper Esq., on Frictional Electricity. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, October 6, Dr. D. B. Reid, on the state of the atmosphere in Westminster, and the improvements of which it is susceptible. At half-past eight.

QUERIES.

Where I may obtain a two-horse power steam boiler on the locomotive principle, and the probable cost and weight without fillings?

JOHN.

The best and cheapest way of constructing a seraphine, and what would be the cost of one about five octaves in compass.

H. W. Y.

SIR,—I have two cast iron retorts which I intend to put in use for certain purposes, one of which is three inches thick, four feet diameter within, and ten feet long; the other is two inches thick, two feet diameter within, and five feet long. These are for dry goods, and I wish to put in the first, with heat from coal fire to be exactly 275 fahrenheit, and the other 293 ditto; if it should rise or fall more than twenty above or twenty below, giving a range of forty, the goods would be spoiled. Can any of your correspondents be kind enough to assist me with a plan to guide the heat to the retorts, so that it would act itself without trusting to the workmen? SPECULATOR.

What is the composition or sizeing applied upon the surface of cordavan leather, commonly called *York cordovan*, to finish it off with? 2. How is the enamelled leather made, what is the ground, and the varnish that is used? 3. How are boot-tops stained such a beautiful brown colour, and how is the polish applied? 4. How is the varnish made that is applied upon boots and shoes, commonly termed French polish? SCRUTOR.

The best method of removing the fur from off the inside of kettles and boilers?

A. C. K.

I feel obliged to "W. H." for the information afforded, and should be farther obliged if he would be so kind to inform me whether I can work gold when brittle? J. C.

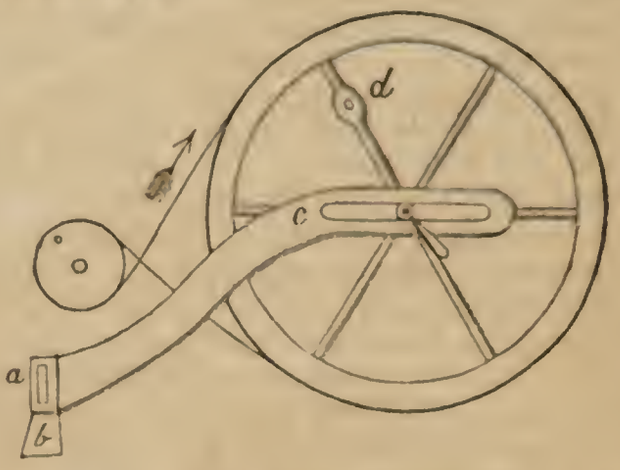
What thicknesses in copper wire, (the No.) are fit to make a hacchoffner's apparatus, in the primary and secondary coils? 2. What length of wire will weigh a pound in each of the requisite sizes? 3. How is the zinc amalgamated for a smees battery? G. S. Jun.

Can oxygen be obtained in a free state by any other means from the atmosphere? 2. Why does platinum become red hot when immersed in a vessel of hydrogen? 3. How can nitrous oxide be procured, except by the decomposition of the nitrate of ammonia? 4. Where can I obtain the work entitled "Consolations in Travel," or "the last days of a Philosopher," written by Sir H. Davy?

H. C.

ANSWERS TO QUERIES.

"X. Y. Z." A watch-makers common lathe can be made to have regular rotary motion as described in No. 86. I fix a bracket on the bar at E and on the head, H, I fit a socket which has a small pin screwed into the face of it to act as a diver.



The above rough sketch may simplify the thing; the bracket at, A, is made to fit tight on to bar at, E, it is best to shrink it on. A lump is left as at, *b*, on purpose to screw it by in the vice. A long slot is made in the bracket at, C, so as to allow the wheel to move backwards or forwards to tighten the band, and the pin on which the wheel works is tightened at any place by means of a thumb screw or wing nut. The boss at *d*, is where the handle is fixed to turn it by; if "X. Y. Z." cannot turn the wheel with one hand and work with the other, let him mount his bar or turning bench on small standards, screw them on a table and have a light wheel with crank and treadle underneath.

"J. Reid." I think if he was to blue them in pounded charcoal, laid on a plate of iron, a sancepan lid, or any handy thing, it would answer better. I have seen it done over a kitchen fire; perhaps your correspondents, Taylor or Bilbrough, will give him the necessary information.

"L. G." is in part incorrect in his answer to "W. W." Gun barrels are made and twisted as he describes, but in many cheap guns imposition is used, the barrels are not twisted. I cannot inform "W. W." how it is done, but I understand it is caused by wool being twisted round the barrel while it is being browned. FARIER.

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

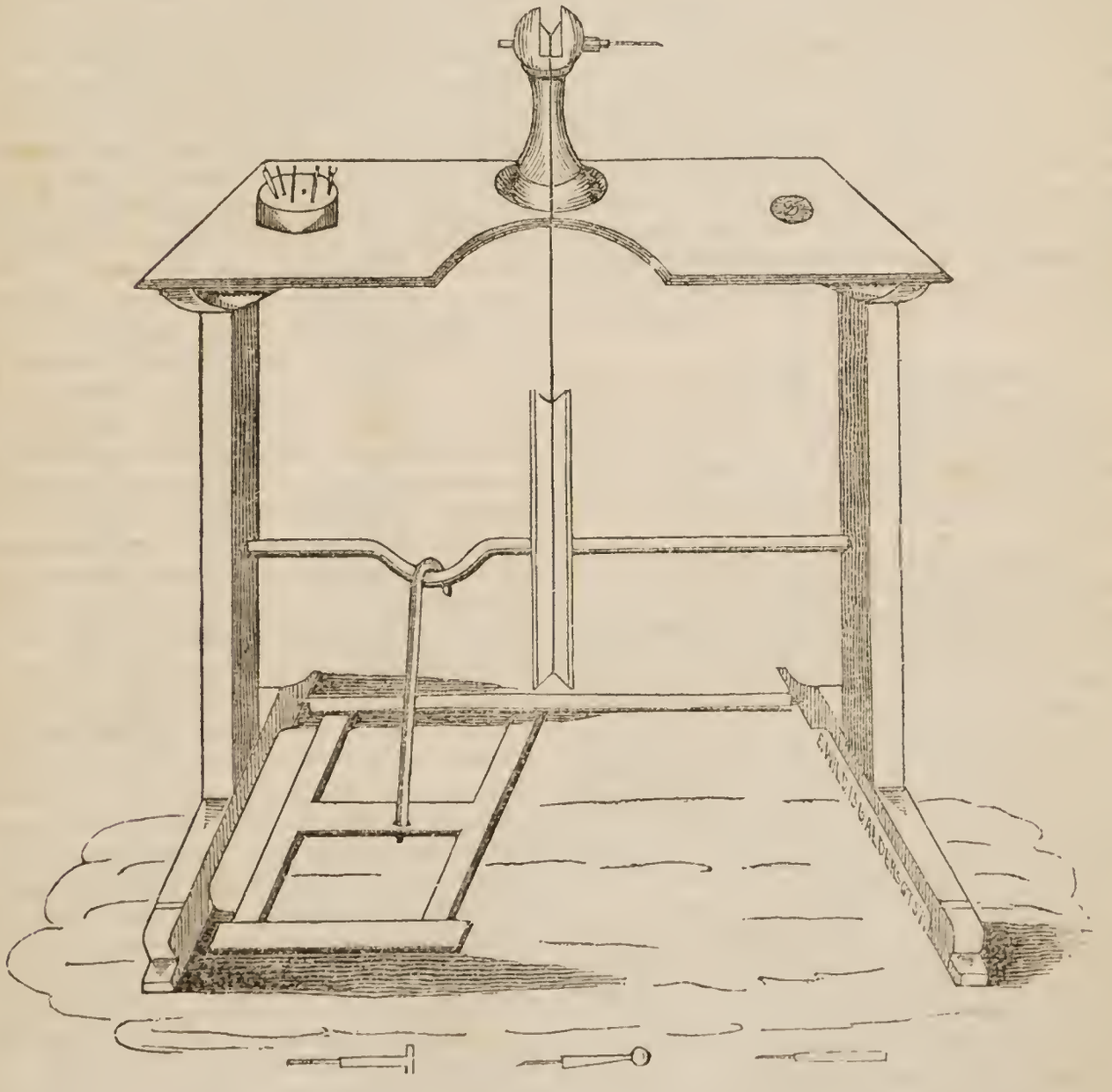
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 104, THIRD SERIES. | SATURDAY, OCT. 8, 1842. | No. 352, OLD SERIES.

SEAL ENGRAVING.



Vol. VIII.—No. 45.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

SEAL ENGRAVING.

(See Engraving, front page.)

Sir,—I send you a description of the method of engraving seals, together with a drawing of the lathe used for that purpose. If any of your readers are desirous of actually seeing this art, they can do so by paying a visit to the Polytechnic Institution, where the process is continually carried on. If you deem it worthy of insertion in your excellent Magazine, it is at your disposal.

I remain, yours respectfully,

H. H.

Description of the Engravings.

The stone to be engraved must of course receive its required form from the lapidary previously to its being put into the hands of the engraver. The operation of the seal-engraver is one of extreme simplicity, yet at the same time combined with great nicety; and a workman before he can venture to put his hand to such a delicate operation, must have previously practised on inferior articles. He may afterwards venture on more valuable substances; for, when it is remembered that he is cutting a valuable gem, it follows, that the slightest mismanagement or scratch would inevitably cause destruction to such an article.

The first thing that the engraver does is, to fasten the seal to the end of a handle by means of cement; he then draws the outline of the subject to be delineated with a diamond point or some other hard substance.

The engraving, front page, represents the lathe. This consists of a table on which an appendage is fixed, called the mill. On this mill the tool is fixed, which is worked in the ordinary way—viz. with a treadle and wheel.

The engraver having fixed the desired tool to the mill, he applies diamond dust, mixed with oil, to the end of it, and, allowing the tool to revolve, he holds the stone to be cut against it, and thereby produces the required delineation.

The last process is, to polish the seal, which is done by fixing tools of boxwood, copper, &c. to the mill, and which are wetted with moistened tripoli, or rottenstone, and are worked in a similar way to those previously described. Lastly, a brush is substituted for these, and the seal is rubbed with it.

An apparatus exactly similar to this is used for engraving on glass.

OXY-HYDROGEN KONIAPHOSTIC, OR LIME LIGHT.

Sir,—Perusing the last Monthly Part of your cheap and useful Magazine, under its miscellanea of queries, I am requested by a correspondent, who signs himself "J. M. J." to give a description of the koniaphostic or lime light, with description of apparatus, its price, and where it can be obtained. To oblige your correspondents, in the dissemination of such scientific knowledge that I possess, has ever been my aim, and I should, had not my other literary and scientific pursuits intervened to prevent me, have acceded to "J. M. J.'s" request much earlier than the present; but trust that the description I now beg leave to submit, will give him all the information he requires. Should it, however, fall short of that, by communicating to me, through the medium of the Mechanic, I should feel great pleasure in assisting him. The koniaphostic or lime light to which "J. M. J." alludes, would be properly termed, the oxy-hydrogen light, being composed of the gases oxygen and hydrogen. These gases, mixed in the following proportions, one part of oxygen and two parts of hydrogen, are set fire to. Intense inflammation ensues, which being projected upon a piece of lime, it immediately becomes of such a white heat, as to throw vivid beams around. Thus, under the name of the koniaphostic light, it was exhibited, a year or two ago, at the Surrey Zoological Gardens; the Drummond light, as it is used in lighthouses; the oxy-hydrogen, when employed to illuminate microscopic instruments. To the readers of The Penny Mechanic, I must apologise for the recapitulation of that which has so repeatedly appeared in its pages—viz. the preparation of the gases oxygen and hydrogen. I should not thus have encroached upon their attention with its repetition, did I not wish to give "J. M. J." every particular necessary for conducting the experiment. To prepare hydrogen gas, procure some granulated zinc and sulphuric acid; place the zinc in a bottle with the sulphuric acid, and add a small quantity of water to it; hydrogen gas will be instantly disengaged; the zinc decomposing the water by uniting with its oxygen. To prepare oxygen gas, place in a retort a quantity of the black oxide of manganese and sulphuric acid; by applying the heat of a spirit-lamp, the oxygen will be disengaged from the manganese. The preparation of the gases being proceeded with, it will evidently be necessary to have some

instrument or apparatus for storing up the gas as it is procured. If "J. M. J." would wish to possess two of Pepys' gas-holders, he may obtain them for 4*l*., of Messrs. Knights, Foster Lane; Palmer, of Newgate Street; or Dymonds, of Holborn; or perhaps, wishing to be a little more economical, two bladders, provided with stop cocks, will do (which I have at times found very convenient temporary gasometers); he may obtain them at either of the above mentioned places at 4s. each. An oxy-hydrogen blowpipe will be indispensable. I will cursorily give him the particulars of a few; space will not permit of my giving the particulars of Dr. Clarke's blowpipe, or Mr. Goldsworthy Gurney's valuable instrument; improvements having since been made upon that gentleman's blowpipe, it will be to those that I shall draw "J. M. J.'s" attention The first improvement was that of a jet, invented by Mr. Hemmings; this jet consists of a cylinder about 4½ inches long and ¾ of an inch in diameter, with a screw at one end to attach the bladder or bag containing the mixed gases, and a jet at the other end, through which the gases issue and are

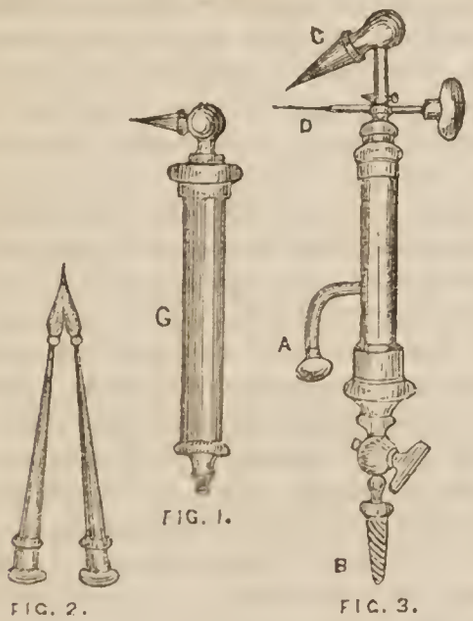


FIG. 2.

FIG. 1. FIG. 3.

burnt. The cylinder, illustrated in fig. 1, G, is filled with exceedingly fine brass wire, cut into lengths and made into a bundle, and then forced into the body of it, so as to occupy the whole of the interior; the gas which enters is compelled to pass through the capillary passages formed between the wires, which, in most cases, is sufficient to prevent the flame from returning, but not in every case. For instance, a few weeks ago I experienced the inconvenience of this jet while delivering a lecture on chemistry; fortunately, the only damage that ensued was the bursting of the bag which contained the mixed gases. To obviate this evil, the following plan was devised:—Two jets are employed, in which the oxygen passes in the one, and the hydrogen through the other, as shown in fig. 1; the gases being by this means kept separate, perfect safety is attained; but the mixing of the gases is not complete, as they do not mingle until they leave the points of the jets. Another plan was that suggested by Professor Daniell; this jet delineated in fig. 3, with attachment for lime cylinder, consists of a long cylindrical tube, ⅜ diameter, 7½ inches long, and internal tube, 6 inches long, 1 inch diameter, with a curved jet 3½ inches long. The hydrogen enters at the end, and passes up the tube, *a*, on the outside of the oxygen-tube; the oxygen enters, and passes up the internal tube, *b*, and comes out at the jet, *c*; D, the lime holder. This would be the oxy-hydrogen blowpipe that I would suggest to "J. M. J." to possess himself of, the price of which will be 1*l*. 3s. It may be purchased of John Ward, Operative Chemist, 79, Bishopsgate Street. The price of Hemmings' jet is 8s., but if "J. M. J." would exercise a little ingenuity, and manufacture one for himself, it would not cost him more than 1s.; the price of the lime-cylinders is 2d. each. Not wishing to be accused of prolixity, I will conclude my remarks, by wishing every success to "J. M. J."

I remain, Sir,
Yours respectfully,
G. STARKEY.

HISTORY OF MEDALS.

(Continued from page 348.)

1. Such as are known to be imitations, but valued on account of the artists by whom they are executed. In this class the medals of the Paduan rank highest; the others being so numerous, that a complete series of imperial medals of almost every kind, nay—almost of every medallion, may be formed from among them. In France, particularly, by far the greater part of cabinets are filled with counterfeits of this kind. They are distinguished from such as are genuine by the following marks: 1. The counterfeits are almost universally thinner. 2. They are never worn or damaged. 3. The letters are modern. 4. They are either destitute of varnish entirely, or have a false one, which is easily known by its being black, shining, and greasy, and very easily hurt by the touch of a needle; while the varnish of ancient medals is as hard as the metal itself. Instead of the greasy black varnish above mentioned, indeed, they have some-

times a light green one, spotted with a kind of iron marks, and is composed of sulphur, verdigrise, and vinegar. It may frequently be distinguished by the hair-strokes of the pencil with which it was laid on being visible upon it. 5. The sides are either filed or too much smoothed by art, or bear the marks of a small hammer. 6. The counterfeits are always exactly circular, which is not the case with ancient medals, especially after the time of Trajan.

The Paduan forgeries may be distinguished from those of inferior artists by the following marks: 1. The former are seldom thinner than the ancient. 2. They very seldom appear as worn or damaged, but the others very frequently, especially in the reverse, and legend of the reverse, which sometimes, as in forged Othos, appear as half consumed by time. 3. The letters in moulds taken from the antique coins have the rudeness of antiquity. 4. False varnish is commonly light green or black, and shines too much or too little. 5. The sides of forged coins are frequently quite smooth, and undistinguishable from the ancient, though to accomplish this requires but little art. 6. Counterfeit medals are frequently as irregular in their form as the genuine; but the Paduan are generally circular, though false coins have often little pieces cut off, in perfect imitation of the genuine. 7. In cast coins, the letters do not go sharp down into the medal, and have no fixed outline; their minute angles, as well as those of the drapery, are commonly filled up, and have not the sharpness of the genuine kind. Where the letters or figures are faint, the coin is greatly to be suspected.

The letters form the great criterion of medals, the ancient being very rude, but the modern otherwise; the reason of which, according to Callini, is, that the ancients engraved all their matrices with the graver or burin, while the modern forgers strike theirs with a punch.

According to Vico, the false patina is green, black, russet, brown, grey, and iron colour. The green is made from verdigrise, the black is the smoke of sulphur, the grey is made of chalk steeped in urine, the coin being left for some days in the mixture. The russet is next to the natural, by reason of its being a kind of froth which the fire forces from ancient coins; but when false, it shines too much. To make it they frequently took the large brass coins of the Ptolemies, which were often corroded, and made them red-hot in the fire; put the coins upon them, and a fine patina adhered. Our author does not say in what manner the iron-coloured patina was made. "Sometimes (adds he) they take an old defaced coin, covered with real patina, and stamp it anew; but the patina is then too bright in the cavities, and too dull in the protuberances. The trial of brass coins with the tongue is not to be despised; for if modern, the patina tastes bitter or pungent, while if ancient, it is quite tasteless."

Mr. Pinkerton informs us, that all medallions from Julius Cæsar to Adrian are much to be suspected of forgery; the true medals of the first fourteen emperors being exceedingly valuable, and to be found only in the cabinets of princes.

2. The second class of counterfeit medals contains those cast from moulds taken from the Paduan forgeries, and others done by eminent masters. These are sometimes more difficult to be discovered than the former, because, in casting them, they can give any degree of thickness they please; and, filling the small sandholes with mastic, they retouch the letters with a graver, and cover the whole with varnish. The instructions already given for the former class, however, are also useful for those of the second, with this addition, that medals of this class are generally lighter than the genuine; because fire rarefies the metal in some degree, while that which is struck is rather condensed by the strokes. In gold and silver medals there cannot be any deception of this kind; because these metals admit not of patina, and consequently the varnish betrays the imposition. The marks of the file on the margin of those of the second class are a certain sign of forgery; though these do not indicate the forgery to be of modern date; because the Romans often filed the edges of coins to accommodate them to the purposes of ornament, as quarter-guineas are sometimes put into the bottom of punch-ladles. It is common to imitate the holes of medals made by time by means of aquafortis; but this destroys the sides of a coin more effectually than if it had been eat into naturally. The fraud, however, is not easily distinguished.

3. In this mode some forgers, as Beauvais informs us, have been so very careful, that they would melt a common medal of the emperor whom they meant to counterfeit, lest the quantity of the metal should betray them. "This (says Mr. Pinkerton), has been done in the silver Septimius Severus, with the reverse of a triumphal arch, for which a common coin of the same prince has been melted; and in other instances." Putting medals in the fire or upon hot iron to cleanse them, gives them

an appearance of being cast; for some spots of the metal being softer than the rest will run, which makes this one of the worst methods of cleaning medals.—The directions given for discovering the two former deceptions hold good also in this.

(To be continued.)

THE CHEMIST.

CHEMICAL ATTRACTION OR AFFINITY.

(Continued from page 350.)

TAKE one ounce and a half of muriate of ammonia, and a like quantity of nitrate of potash; reduce each of these salts separately to a powder, and blend them intimately together: having done this, mix them gradually in a glass basin, or other thin glass vessel, with four ounces of water. The result will be, that the cold produced will sink a thermometer immersed in it, to 36° Fahr. A new addition of the same quantity of salts will cool it to 14°, which therefore will freeze water in a glass tube that is immersed in it, without the use of snow or ice. If the water used in a first process be used to reduce other water and salts to the temperature of about 32°, and these be applied to the performance of a second experiment, the temperature may be lowered to 4° below 0°.

A number of experiments have been made to produce artificial cold by means of such freezing mixtures. The most complete set of this kind are those of Pepys, Lawitz, and Walker.

5. The agency of chemical affinity between two or more bodies may lie dormant, until it is called into action by the interposition of another body, which frequently exerts no energy upon any of them in a separate state.

From this law originates what was formerly called disposing affinity, or that case in which two or more bodies are incapable of uniting, until the agency is called into action by the addition of a third body, which exerts no sensible affinity upon either of them. This may be proved in the following manner:—

Water is a compound of hydrogen and oxygen; phosphorus is a simple body according to our present state of knowledge. If these be presented to each other, no chemical union will take place; but if we add to them an alkali, and then apply heat, the water will become decomposed; that is to say, part of the phosphorus will unite to the oxygen of the water, and form phosphoric acid, and the other part will be dissolved in the hydrogen gas, and appear as phosphorated hydrogen.

Here the alkali acts as the substance requisite to favour the mutual action, or to give the disposing affinity.

If iron and water be brought into contact with each other, no perceptible change will be produced; but if a little sulphuric acid be added to the water and iron, a violent effervescence will take place, the water will become decomposed, hydrogen gas will be evolved, and the iron become dissolved in the acid.

In this case the sulphuric acid is the condition necessary to accelerate the chemical action.

6. The ratio of the energy of chemical affinity acting between various bodies, is different in different substances.

This is the most important law of chemical attraction. As beginners will find it rather difficult to understand what passes in this more complicated agency, they must remember, that the combination which is effected between two or more bodies by virtue of chemical affinity, becomes broken whenever we present to the compound another body, which has an attraction to one of the constituent parts of the compound, superior to that attraction by which they were held together: the bodies, therefore, between which the strongest attraction prevails, combine, and the rest are disengaged thus:—

If muriatic acid be poured either on pure barytes, or on its carbonate, the barytes will be dissolved and the compound will be muriate of barytes, which compound is held together by the force of affinity existing between the muriatic acid and the barytes. On letting fall into this solution a few drops of sulphuric acid, an immediate change of principles takes place; the whole quantity of the muriatic acid which was combined with the barytes becomes disengaged, and the sulphuric acid unites to the barytes with a force equal to their affinity, *minus* that of the muriatic acid.

Again, if pure silver be dissolved in pure nitric acid, the silver will remain united to the acid, till another body is presented to it, which has a greater force of attraction to one of the constituent parts of the compound; for instance, if mercury be added to this solution of silver, the mercury will be dissolved, and the silver becomes precipitated or disengaged. The supernatant fluid will then be a *solution of mercury in nitric acid.*

If to the before-obtained solution of mercury in nitric acid, a piece of sheet lead be presented, the lead will be dis-

solved, and the mercury become precipitated. The fluid will then be a *solution of lead in nitric acid.*

If in this solution of lead, a thin slice of copper be suspended, the copper will be dissolved, and the lead will become disengaged. The fluid now is a *solution of copper in nitric acid.*

If in this solution of copper, a thin sheet of iron be kept immersed, the iron will be dissolved, and the copper become precipitated. The fluid now is a *solution of iron in nitric acid.*

If to this solution of iron, a piece of zinc be presented, the zinc will be dissolved, and the iron become precipitated. The solution then consists of *zinc and nitric acid.*

If to this solution of zinc in nitric acid, some ammonia be gradually added, the ammonia will join to the acid, and the zinc will be precipitated. The solution will then be *nitrate of ammonia.*

If to this solution of nitrate of ammonia, some lime water be added, the ammonia will become disengaged (and manifest itself by a pungent odour), and the solution will be *nitrate of lime.*

If to this solution of nitrate of lime, some oxalic acid be added, the lime will be precipitated, and what now remains will be merely *nitric acid.*

(To be continued.)

MISCELLANEA.

Autumn Tillage.—It is admitted by all experienced farmers, that the success of spring-sown crops materially depends on the preparation of the land in the previous autumn. The only question at issue is as to the best mode of performing it, so as to insure the greatest amount of benefit from the chastening influence of the winter months. It is with many the common practice to plough stubble and other land in the same way as would be done for the seed furrow in spring. A correspondent says, "I have been led to think that in this way the land is deprived of the full benefit of the frost; and on the trial of the plan now recommended, and which I found answered my most sanguine expectations last year, I am induced strongly to propose it for general adoption. It is this:—As soon as possible in the autumn, I send a man with two horses and a one-wheel plough to throw up the land into ridges. As soon as this is completed, I remove the turnfurrow from the same plough, and substitute a double-winged share for the one used in ploughing, and with this simple implement thoroughly subsoil the intervals between the ridges. After this has lain up to the action of the atmosphere—say two months—I reverse the ridges, either with the same plough, or, if more expedition be required, employ a double mould board, which reverses the ridges at one operation; the subsoil plough is again employed between the intervals newly created by reversing the ridges, and then the whole of the land is completely stirred to any depth according to the land, but on an average say one foot deep throughout. The whole field thus treated is now left to the spring, when the ridges are levelled with the harrows, and ploughed in the usual way, when the land will be found in a fine state of pulverisation. The advantages of this kind of tillage are as follows:—1. A much larger surface is exposed to the action of the atmosphere. 2. A gradually increasing depth of soil is obtained, without any improper intermixture of unfertile subsoil; as it is not mixed with the surface soil, but lies up to the ridges to be pulverised by the frost, and rendered more or less absorbent of moisture, as the case may be. 3. The wireworm and all insects are effectually destroyed, as the frost can by these means penetrate into their winter quarters. 4. All root-weeds and couch are most completely eradicated. 5. Land on which sheep have been penned can be moved to any depth required, without placing the manure beneath the surface. 6. Land treated in this way does not suffer so much from drought in the summer months, the cultivated subsoil retaining moisture, which by the radiation of heat is supplied to the roots of plants. 7. Land thus subsoiled is ploughed with much greater ease than when it is ploughed only two or three inches deep. All these advantages can be obtained without the use of expensive implements or increased strength in the team—a one-wheel plough, a double-winged share, a pair of good horses, and a man, being all that is required."—*Worcester Chronicle.*

Specific Gravity or Statics.—In one of Newton's speculations, he imagined that, if the matter of the whole earth were compressed into absolute solidity, it might be reduced to a body but a few yards in diameter. Reduced to a sphere of one mile in diameter, the matter to the interstices would be but 1 to 510,000,000,000.

The force or momentum of a body in motion, is the quantity of atoms which it contains, by its velocity in the line of direction of the centre of all the atoms united in the mass.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, October 12, R. A. Ogilvie, Esq., on the Natural History and Physiology of Birds. Friday, October 14, J. H. Pepper, Esq., on Frictional Electricity. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, October 13, Dr. D. B. Reid, on the Ventilation of Public Buildings and Dwelling-houses in Westminster. At half-past eight.

QUERIES.

What is the use of the fly-wheel? Is it to gain power, or regulate motion?

J. COUCHMAN.

I shall feel greatly obliged to any reader of the PENNY MECHANIC that will inform me of a way to extract a stain of Indian ink from an engraving. W. C.

I have a form of locomotive engine, which I believe to be original, and which I believe possesses many advantages which the present form does not possess. I wish to part with the plan, and shall be very glad to be informed to whom to apply. I will forward drawings to any one who will promise to keep the plan secret, if he does not approve of it, and return it to me. RUSTICUS.

The cheapest and easiest method of making sensitive paper for the calotype process. Or can it be bought? If so, where, and what is the price per sheet? J. Y.

Having lately purchased one of Hutchinson's floating lights, of a description called "Nautilus"—being a small metal cup, in the centre of which is fixed a capillary tube of glass, which is placed on the surface of oil; the same ascending to the summit of it, and a lighted paper being applied, it ignites, and affords a very pretty light during the night—I wish to be informed what is the reason that no other material will answer for a tube besides glass. 2. Can you inform me where I can purchase German silver at the cheapest rate? The kind I want is in very thin rolled sheets; I know it can be had in Foster Lane, at Knight's, but I want a cheaper market.

M. D. W.

SIR,—Will you or any of your numerous correspondents inform me, the best process for silvering looking-glasses; and how tortoise-shells are prepared, that they may be compressed into any shape; also the sort of size, &c., used for plaster casting preparatory to gilding? G. L.

ANSWERS TO QUERIES.

I think one of your correspondents, "An Amateur Mechanic," is certainly mistaken respecting the price of a slide-rest. There is a description of one in a work published lately, I believe it is the "Dictionary of Arts and Sciences," and published by W. Brittain, Paternoster Row. I had the whole work, but gave it to a friend of mine. In a description of a fog alarum, the inventor has omitted to state how the bell is to be kept in action when the vessel is at anchor; for instance, in a fishing-boat, which class of vessels are so apt to be run down in a fog, as there are often a complete fleet of them together.

SIR,—A correspondent, "X. Y. Z.," inquires in No. 100 of the PENNY MECHANIC, the best way to platinize silver. The electrotype way is not only the cheapest but best method, as the following will show: it is an extract from the second part of Walker's treatise on Electrotype Manipulation, published by Knight & Sons, Foster Lane, Cheapside. I cannot too strongly recommend this work, as it gives the most full and practical explanations and directions for practising this delightful art, and the trifling price (1s. each part of about fifty pages) places it within the reach of all classes.

"§ 139. *Platinization.*—A small quantity of the *bichloride of platinum* is mixed with acid water, and the solution is decomposed by the use of a *platinum terminal* in connexion with the copper of the battery, and the substance to be platinized in connexion with the zinc. A few minutes' action will suffice." Now the vessel containing the solution can be made of wood, coated with a mixture of resin and bees' wax to make it water-tight, of the shape of the silver foil to be platinized, so as to require but a very small portion of the solution, and the platinum anode can be formed of a thin slip of platinum foil.

"P. H." inquires what preparation organ-builders use, to render the wind-box, &c., air-tight, the wood being porous. None. There is no perceptible waste of wind from that cause. If "P. H." finds the wind escape, it is from some fault in the workmanship; the grooves may not be planed true, so that the pallets do not fit well; the wind may escape at the joints of the wind-chest—this can be remedied by glueing a slip of paper over them. The pallets should be covered with a double thickness of soft and thick sheep skin, the inside of the skin being outwards; or the wind may escape from the holes through which the pull wires work, being too large. "P. H." may have fancied some preparation is used, from seeing the wooden pipes covered with a mixture of size and red lead, but this is only for the sake of appearance.

G. S., Jun.

"J. W." (No. 102.) will find all the works I quoted in No. 99, at the British Museum, but he must obtain a reading-ticket before he will be admitted to the library. Dr. Ure's "Dictionary of Chemistry," is an invaluable book; it is published by Mr. Tegg, Cheapside, and may be purchased for about 15s. Dr. Rees' "Cyclopædia" is a very voluminous work, and by far the most exact hitherto published; it

may be had in the present state of the market for about 16*l.* or 18*l.* Mr. Dowding, bookseller, in Newgate Street, has the whole of the remaining stock; but should "J. W." feel disposed to purchase, he must be very careful, as many sets are incomplete. I think I can point out a source where he might meet with a perfect copy, if he will favour me with his address.

"P. H." It would be scarcely fair to print Professor Willis' method of forming the teeth of wheels by an apparatus, which he designates an odontograph; especially as the professor has lately published a treatise, entitled "Principles of Mechanism," which doubtless contains an exposition of his method. "P. H." will also find it in Rennie's edition of "Buchanan on Mill-work," and in the "Transactions of the Society of Civil Engineers."

"D. M." What he means by calcined water I am utterly at a loss to imagine, perhaps he will explain himself. Respecting the composition of crucibles, fire-clay, or any refractory clay, mixed with sand and black-lead, may be quoted; but there are particular exceptions, which he will find explained in almost any chemical work of authority. He may consult "Herbert's Engineers' and Mechanics' Encyclopædia," vol. i. p. 423.

"X. Y. Z." will find a good lathe a very expensive article. Under any circumstances, he had better not lay out his money at a tool-shop; as nine-tenths of the lathes exposed for sale, are wretched trash. His best plan will be, to go to some respectable maker, and I can give him the address of such a one whose work is excellent and his charges moderate. However there are some vendors of tools, who are also manufacturers: for instance, Mr. Fenn, of Newgate Street, whose reputation is guaranteed by the experience of more than half-a-century. For light work, and indeed in every case where the radius of the lathe is within nine or ten inches, a bar lathe is, on many accounts, to be preferred; but for heavy engineering work, a bed lathe is generally used, on the supposition that a bar is not sufficiently steady—a manifest and egregious blunder, as was proved by the late Mr. Maudslay, of Westminster Bridge Road, who employed no other than bar lathes in his steam-engine manufactory.

"J. Reid." It is extremely difficult to obtain a satisfactory result in blueing steel in the manner he indicates. The French and Swiss clock-makers excel in this branch of their art; and I believe I have a full statement of their plan, which, should he be unable to procure, I will cause to be copied for him at as low a rate as possible. I regret my occupations prevent me doing it myself.

AN AMATEUR MECHANIC.

SIR,—In answer to one of your correspondents of some weeks back, as to how cast iron was made malleable, &c. The process is as follows:—When the castings come from the sand, they are put into an oven similar to a baker's oven, except that the flue is underneath the floor; then when the castings are arranged best for heating, &c., carbonate of iron is thrown in in great quantities upon them until the whole are covered; the stove is then closed, and a constant and regular heat is kept up from four to six days, according to the substance of the castings, when the fire is raked, and the above left to cool gradually of itself; and, when cool, they are taken out. The surface is found beautifully variegated, like unto that of a peacock's tail, and the body of the casting nearly as white as silver, and as soft as the very best malleable iron. I have seen nails, bolts, links, gas-tubes, &c. &c., of this iron, all of which could be upset or drawn down at pleasure when heated; and indeed when cold could be doubled up, straightened, and doubled again, without breaking. G. L.

"E." is informed that he can learn all particulars as to price, &c., by applying (by post) at the Polytechnic Journal Office, 13, Wellington Street, North. The machine by Adams, stands 24½ inches high, the cylinder is 32½ inches in circumference. It has negative and positive conductors, and in short possesses all the necessary qualities for experimenting. Together with it are a set of bells, an apparatus for igniting alcohol—a tube for showing the electric light—a discharger, jointed—a glass handle, mounted—apparatus for showing the aurora borealis electric star—one glass-legged stool—an electrometer, &c. &c. There are a few small Leyden jars; the price will be very reasonable, as the writer is about leaving town. A. O. Z.

"E. L." is informed that the best test for silver is hydrochloric (muriatic) acid, which throws down a copious white precipitate of chloride of silver. Paper when immersed in a solution of this, becomes black by exposure to the atmosphere; and it may, for this reason, be used instead of the nitrate for photogenic drawing. H. C.

I think the best work "E. G." can consult, is that published by Mr. Gwilt, on shadows. It is a thin octavo volume, and can be procured at Weale's, Holborn. W. C.

TO CORRESPONDENTS.

Vapor.—*The diagram of his Semi-rotative Engine having been mislaid, he would oblige by forwarding another to us. We have the description.*

B. Y., Hanley. *We shall be obliged by his communications, as promised.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

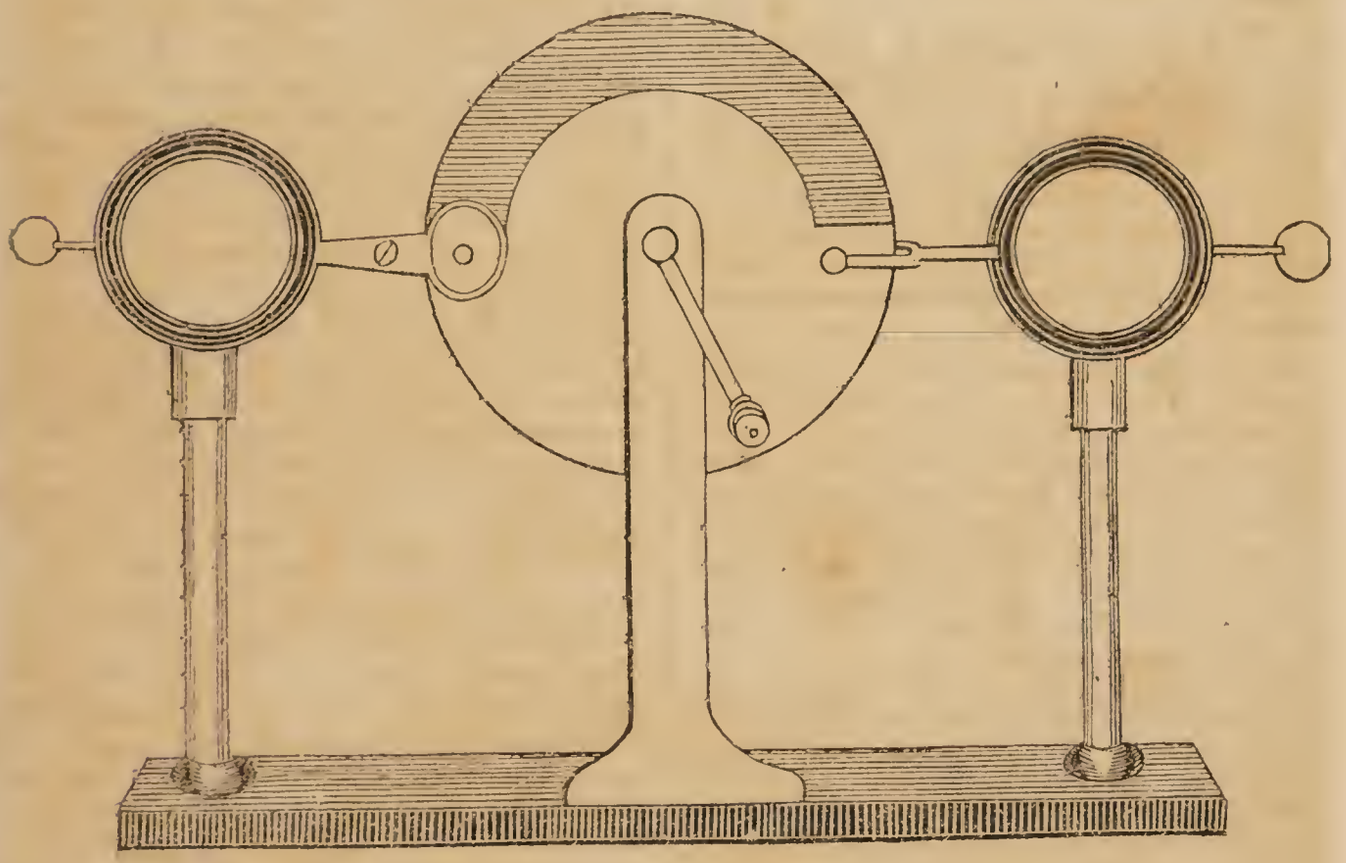
THE PENNY MECHANIC

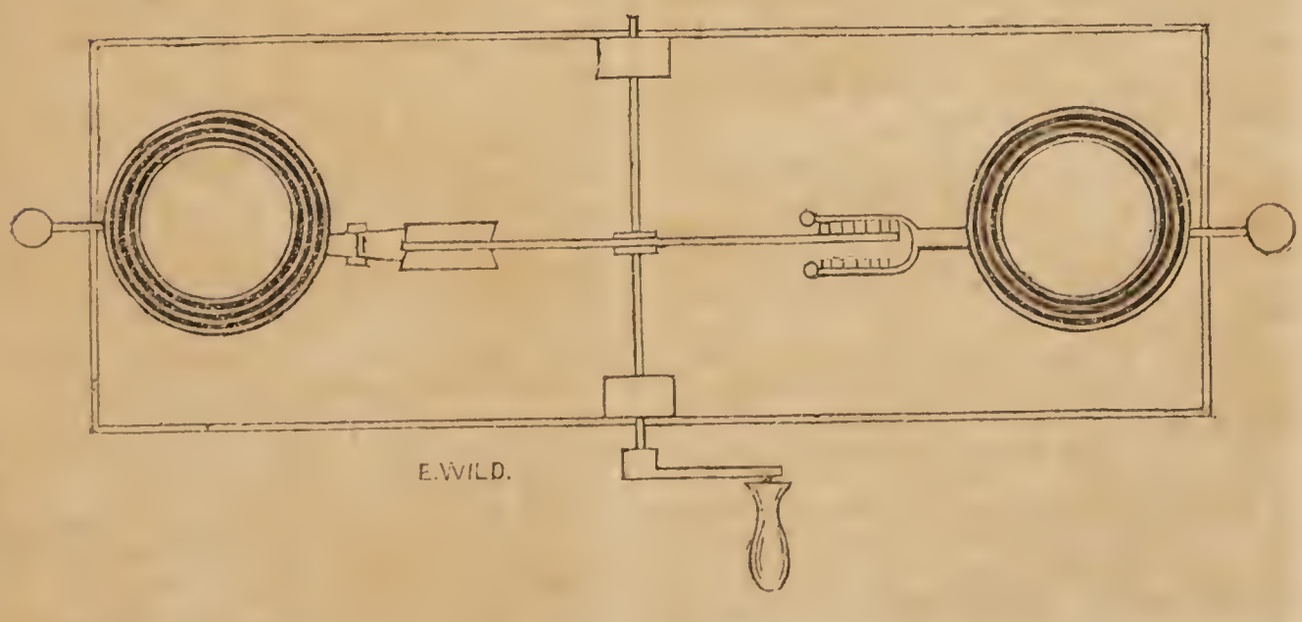
AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. **105**, THIRD SERIES. | SATURDAY, OCT. 15, 1842. | No. 353, OLD SERIES.

WAGSTAFF'S ELECTRICAL MACHINE.





Vol. VIII.—No. 46.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

WAGSTAFF'S ELECTRICAL MACHINE.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Finding that many of your readers are, like myself, lovers of electricity, and, as I have been studying that science some years, I am persuaded that the plate machine possesses many advantages over the cylinder; but, as it (the plate machine) is generally made, it is wanting in one particular point—viz. the possibility of getting negative electricity, without which, a great number of pleasing and useful experiments cannot be performed. I have made a plate machine, in which this objection likewise is removed; and, at the same time, so simple in its construction as to need no description, a sight of it being a sufficient explanation. Fig. 1 is a front view, and fig. 2, a bird's eye view, of the machine.

Yours &c.,

P. Wagstaff.

REGULATED SPEED IN SURFACE TURNING.

To the Editor of the Penny Mechanic and Chemist.

Sir,—It affords me sincere pleasure to find that my efforts to promulgate practical knowledge among a class of men, actually engaged in mechanical pursuits, have tended to excite a spirit of inquiry; because this circumstance in itself proves, that neither have my exertions been misdirected, nor has my labour been fruitlessly bestowed. I am induced, therefore, to indulge a hope, that others will follow the example of your correspondent, "G. Lodge," and favour me, through the medium of your Journal, with the results of their experience. Ingenious as is the method suggested by "G. Lodge," and satisfactory as it may look upon paper; I fear it is not sufficiently precise and accurate in its movements, to meet the exigency of the case. Reversed cones, as regulators of speed, have been frequently applied, but never, I believe, successfully, to surface turning; unless accompanied and assisted with other apparatus; the expense of which obviously renders them unfit for the artizan.

If "G. Lodge" will refer to my communication in No. 100, p. 223—4, he will see that I have, in some measure, anticipated any plan that depends on conical pulleys only, as inapplicable to the proposed object. Two things appear to me essentially requisite: 1st, continuous motion; 2nd, that the progress of the tool to or from the centre of the work, be made to govern the speed of the lathe-mandril; and neither of these is obtained by the method recommended by "G. Lodge." The action of a forked lever on a projecting stud, would necessarily cause a jar or check; which, although scarcely appreciable, would still produce, to a certain extent, the effects of an entire stop—namely, a false cut; added to which, it must be remembered, that the eye and the hand of the workman are by no means sufficiently accurate to determine the precise moment to change the velocity. It is extremely difficult to form a correct estimate of any mechanical contrivance from a mere verbal description; I have therefore to request from "Mr. Lodge," a drawing of his plan, the insertion of which in the Penny Mechanic will, I am sure, be highly esteemed by a large proportion of your numerous readers; and by none more than

Your obedient Servant,

An Amateur Mechanic.

MANUFACTURE OF ISINGLASS.

In answer to a respected correspondent who wishes to know the method of manufacturing isinglass, we cannot do better than extract the following from a work, entitled "Smith's Practical Inventions." It will, no doubt, be acceptable.

"If glue be dissolved in a sub-acid fluid, such as stale beer, and mixed with fermented liquors, it forms with them a mucilaginous liquor, like diluted gum-water, and, instead of clarifying them, increases both their tenacity and turbidness; but if isinglass be dissolved and added to fermented liquors in a similar manner, it forms the best composition known for fining such liquors. Here is observable a very important difference in the action of glue and isinglass, and the due consideration of it laid open the real nature of the latter. If what is commercially termed long or short stapled isinglass, be steeped a few hours in fair cold water, the entwisted membranes will expand, and reassume their original beautiful hue, and, by a dexterous address, may be perfectly unfolded. Thus we find that isinglass is actually nothing more than certain membranous parts of fishes, divested of their native mucosity, artfully rolled and twisted, and dried in the open air.

The sounds or air-bladders of fresh-water fish, in general, are preferred for this purpose, as being the most transparent, flexible, delicate substances. These constitute the finest sorts of isinglass; those called book and ordinary staple, are

made of the intestines, and probably the peritonæum of the fish. The Beluga yields the greatest quantity, as being the largest and most plentiful fish in the rivers of Russia; but the sounds of all fresh-water fish yield, more or less, fine isinglass, particularly the smaller sorts, found in prodigious quantities in the Caspian Sea, and several hundred miles beyond Astracan, in the Wolga, Yaik, Don, and even as far as Siberia, where it is called *kle* or *kla* by the natives, which implies a glutinous matter; it is the basis of the Russian glue, which is preferred to all other kinds for its strength.

"The sounds, which yield the finest isinglass, consist of parallel fibres, and are easily rent longitudinally; but the ordinary sorts are found composed of double membranes, whose fibres cross each other obliquely, resembling the coats of a bladder. Hence the former are more readily pervaded and divided by sub-acid liquors; but the latter, having a peculiar kind of interwoven texture, are with great difficulty torn asunder, and long resist the power of the same menstruum; yet, when duly resolved, are found to act with equal energy in clarifying liquors.

"Isinglass receives its different shapes in the following manner:—The parts of which it is composed, particularly the sounds, are taken from the fish while sweet and fresh, slit open, washed from their slimy *sordes*, divested of every thin membrane which envelopes the sound, and then exposed to stiffen a little in the air. In this state they are formed into rolls about the thickness of a finger, and in length according to the intended size of the staple: a thin membrane is generally selected for the centre of the roll, round which the rest are folded alternately, and about half-an-inch of each extremity of the roll is turned inwards. The due dimensions being thus obtained, the two ends of what is called short staple are pinned together with a small wooden peg; the middle of the roll is then pressed a little downwards, which gives it the resemblance of a heart shape, and thus it is laid on boards, or hung up in the air to dry. The sounds which compose the long staple, are larger than the former; but the operator lengthens this sort at pleasure, by interfolding the ends of one or more pieces of the sound with each other. The extremities are fastened with a peg, like the former; but the middle part of the roll is bent more considerably downwards; and, in order to preserve the shape of the three obtuse angles thus formed, a piece of round stick, about a quarter of an inch in diameter, is fastened in each angle with small wooden pegs, in the same manner as the ends. In this state it is permitted to dry long enough to retain its form, when the pegs and sticks are taken out, and the drying completed. Lastly, the pieces of isinglass are colligated in rows, by running packthread through the peg-holes for the convenience of package and exportation.

"The membranes of the book isinglass, being thick and refractory, will not admit a similar formation with the preceding: the pieces, therefore, after their sides are folded inwardly, are bent in the centre, in such a manner that the opposite sides resemble the cover of a book, whence its name; a peg being run across the middle, fastens the sides together, and thus it is dried like the former. This sort is interleaved, and the pegs run across the ends, the better to prevent its unfolding.

"Isinglass is best made in the summer, as frost gives it a disagreeable colour, deprives it of weight, and impairs its gelatinous principles. Its fashionable forms are unnecessary, and frequently injurious to its native qualities. It is common to find oily putrid matter, and *exuviæ* of insects, between the implicated membranes, which, through the inattention of the cellarman, often contaminate wines and malt-liquors in the art of clarification. These peculiar shapes might probably be introduced originally with a view to conceal the real substance of isinglass, and preserve the monopoly; but for this purpose, they are now useless, and in its native state, isinglass might be afforded rather cheaper than at present, and its efficacy would be increased rather than diminished. Although a preference is given to fresh-water fish, as affording isinglass of the very finest quality, and therefore the interior of Canada may be the most proper country to which we may look for vast supplies of this substance; yet the manufacture of it may be rendered a valuable appendage to the marine fisheries, as will appear by the following details:—

"The sounds of cod and ling bear a great analogy to those of the *accipenser* genus of Linnæus and Artedi, and are in general so well known as to require no particular description. The Newfoundland and Iceland fishermen split open the fish, as soon as taken, and throw the backbones, with the sounds annexed, in a heap; but, previously to incipient putrefaction, the sounds are cut out, washed from their slime, and salted for use. In cutting out the sounds, the intercostal parts are left behind, which are much the best: the

Iceland fishermen are so sensible of this, that they beat the bone upon a block with a thick stick, till the pockets, as they term them, come out easily, and thus preserve the sound entire. If the sounds have been cured with salt, that must be dissolved by steeping them in water, before they are prepared for isinglass: the fresh sound must then be laid upon a block of wood, whose surface is a little elliptical, to the end of which a small hair-brush is nailed, and, with a saw-knife, the membranes on each side of the sound must be scraped off. The knife is rubbed upon the brush occasionally, to clear its teeth; the pockets are cut open with scissars, and perfectly cleansed of the mucous matter with a coarse cloth: the sounds are afterwards washed a few minutes in lime-water, in order to absorb their oily principle, and lastly in clear water. They are then laid upon nets to dry in the air; but, if intended to resemble foreign isinglass, the sounds of cod will only admit of that called hook, but those of ling both shapes. The thicker the sounds are, the better the isinglass, colour excepted; but that is immaterial to the brewer, who is its chief consumer.

"This isinglass resolves into fining, like the other sorts, in sub-acid liquors—as stale beer, cider, old hock, &c. and in equal quantities produces similar effects upon turbid liquors, except that it falls more speedily and closely to the bottom of the vessel; but foreign isinglass retains the consistency of fining preferably in warm weather, owing to the greater tenacity of its native mucilage. Vegetable acids only should be employed in fining.

"We subjoin the following method of forming a very excellent glue with isinglass:—Take an ounce of isinglass, pound it in a mortar, and, when it is in small pieces, put the whole into a half-pint phial; fill the phial with common gin, put a cork into it with a notch cut in one side, that the vapour may escape; place it near the fire, and shake it often till the isinglass is dissolved. Strain off the whole, and keep it in a clean phial, well corked for use. This glue will be good for many years, and is a very convenient preparation for a number of purposes. By warming, it becomes fluid and fit for use. It is extremely suitable for taking impressions of medals, and it may be coloured by mixing pigments with it, or ornamented by gilding. The glue, if mixed with equal proportions of good drying oil, forms a cement for joining earthenware, china, &c. and for articles which have to bear exposure to the weather; the cement, thus prepared and used, should be dried in an oven. The glue, with two parts of boiling water, mixed up with emery and lamp-black, forms, when two or three coats are laid upon stiff paper, the slate-paper employed for pocket-books."

HISTORY OF MEDALS.

(Continued from page 357.)

4. This is a class of counterfeits more difficult to be discovered than any other. "The art (says Mr. Pinkerton) exerted in this class is astonishing; and a connoisseur is the less apt to suspect it, because the coins themselves are in fact ancient. The acute minds of the Italian artists exerted themselves in this way, when the other forgeries became common and known. With engraving tools they alter the portraits, the reverses, and the inscriptions themselves, in a surprising manner. Of a Claudius struck at Antioch, they make an Otho; of a Faustina, a Titiana; of a Julia Severa, a Didia Clara; of a Macrinus, a Pescennius, &c. Give them a Marcus Aurelius, he starts up a Pertinax, by thickening the beard a little, and enlarging the nose. In short, whenever there is the least resemblance in persons, reverses, or legends, an artist may, from a trivial medal, generate a most scarce and valuable one. This fraud is distinguishable by the false varnish which sometimes masks it; but, above all, by the letters of the legend, which are always altered, Though this be sometimes done with an artifice almost miraculous, yet most commonly the characters straggle, are disunited and not in a line."

In counterfeits of this kind, sometimes the obverse is not touched, but the reverse made hollow, and filled with mastic coloured like the coin, and engraven with such device and legend as was most likely to bring a great price; others are only retouched in some minute parts, by which, however, the value of the coin is much diminished. "Against all these arts (says Mr. Pinkerton) severe scrutiny must be made by the purchaser upon the medal itself; and the investigation and opinion of eminent antiquaries had upon its being altered, or genuine as it is issued from the mint."

In th first article of this class, the reverses had been totally filed off, and new ones impressed with a die and hammer. This is done by putting the face or obverse, whichever is not touched, upon different folds of pasteboard, afterwards applying the die and striking it with a hammer. The forgery in this class is very easily discovered, as the devices and in-

scriptions on the counterfeits are known not to exist on true medals: as the Pons Ælius on the reverse of Adrian: the Expeditio Judaica of the same emperor, &c. The difference of fabrication in the face or reverse will be discovered at the first glance by any person of skill.

The soldered medals consist of two halves belonging to different medals, sawed through the middle and then jointed with solder. This mode of counterfeiting is common in silver and brass coins. "They will take an Antoninus, for example, and saw off the reverse, then solder to the obverse which they have treated in the same manner. This makes a medal, which, from an unknown purchaser, will bring a hundred times the price of the two coins, which compose it. When the deceit is used in brass coins, they take care that the metals be of one hue; though indeed some pretenders in this way sometimes solder copper and brass together, which at once reveals the deceit. Medals which have a portrait on each side, and which are generally valuable, are the most liable to a suspicion of this fraud. To a very nice eye the minute ring of solder is always visible; and upon inserting a graver, the fabrication falls into halves."

In the same manner reverses are sometimes soldered to faces not originally belonging to them; as one mentioned by Pere Jobert, of Domitian with an amphitheatre, a reverse of Titus joined to it. Another art is sometimes made use of in this kind of counterfeits, of which there is an instance in the temple of Janus upon Nero's medals; where the middle brass is taken off, and inserted in a cavity made in the middle of a large coin of that prince. In the coins of the lower empire, however, the reverses of medals are sometimes so connected with their obverses, that the suspicion of forgery sometimes occurs without any foundation. They are met with most commonly after the time of Gallienus, when such a number of usurpers arose, that it was difficult to obtain an exact portrait of their features; the coiners had not time, therefore, to strike a medal for these as they could have done for other emperors who reigned longer. Hence, on the reverse of a medal of Marius, who reigned only three days, there is PACATOR ORBIS, which shows that at that time they had reverses ready fabricated, to be applied as occasion might require.

6. It has been already remarked, that many true medals are cracked in the edges; owing to the repeated strokes of the hammer, and the little degree of ductility which the metal possesses. This the forgers attempt to imitate by a file; but it is easy to distinguish betwixt the natural and artificial cleft by means of a small needle. The natural cleft is wide at the extremity, and appears to have a kind of almost imperceptible filaments; the edges of the crack corresponding with each other in a manner which no art can imitate.

The plated medals which have been forged in ancient times were long supposed to be capable of resisting every effort of modern imitation; but of late years, "some ingenious rogues (says Mr. Pinkerton), thought of piercing false medals of silver with a red-hot needle, which gave a blackness to the inside of the coin, and made it appear plated to an injudicious eye. This fraud is easily distinguished by scraping the inside of the metal." It is, however, very difficult to distinguish the forgeries of rude money, when not cast; and our author gives no other direction than to consult a skilful medallist. Indeed, notwithstanding all the directions already given, this seems to be a resource which cannot by any means with safety be neglected. A real and practical knowledge of coins "is only to be acquired (says he) by seeing a great number, and comparing the forged with the genuine. It cannot therefore be too much recommended to the young connoisseur, who wishes to acquire some knowledge in this way, to visit all the sales and cabinets he can, and to look upon all ancient medals with a very microscopic eye. By these means only is to be acquired that ready knowledge which enables at first glance to pronounce upon a forgery, however ingenious. Nor let the science of medals be from this concluded to be uncertain; for no knowledge is more certain and immediate, when it is properly studied by examination of the real objects. A man who buys coins, trusting merely to his theoretic perusal of medallic books, will find himself wofully mistaken. He ought to study coins first, where only they can be studied, in themselves. Nor can it be matter of wonder or implication of caprice, that a medallist of skill should, at one perception, pronounce upon the veracity or falsehood of a medal; for the powers of the human eye, employed in certain lines of science, are amazing. Hence a student can distinguish a book among a thousand similar, and quite alike to every other eye: hence a shepherd can discern, &c.; hence the medallist can say in an instant, 'This is a true coin, and this is a false,' though to other people no distinction be perceptible."

(To be continued.)

THE CHEMIST.

CHEMICAL ATTRACTION OR AFFINITY.

(Concluded from page 358.)

We see from these experiments, that different bodies have different degrees of affinity for one and the same substance, which can only be learnt from observation and experiments.

7. The agency of chemical affinity is either limited or unlimited; in other words, chemical affinity is capable of uniting bodies in definite, or in indefinite proportions:—

Experience has convinced us that in all bodies there are certain precise limits of combination, beyond which their action cannot pass—namely a *minimum*, and a *maximum*; it remains still to be ascertained how bodies can combine within these limits.

If we attend to what is known at present, we are forced to acknowledge that this law comprehends several modifications, which may be arranged under the following classes:—

1. Chemical affinity unites several bodies in any proportions whatsoever; their combination is therefore united; for instance—

If water and ardent spirit be mingled together in any quantity, a chemical combination ensues; for the compound obtained has always a specific gravity different from the mean specific gravity of the fluids combined. Its bulk is likewise not the arithmetical mean of the fluids in a separate state.

The same is the case when liquid acids and water, or acids and ardent spirit, are combined together.

2. Chemical affinity combines several bodies to a certain extent or *maximum* only.

To this class belong all those bodies which are capable of saturation.

If we take a quantity of any of the dense acids diluted with water, for instance, sulphuric acid, and let fall into it a solution of an alkali, for example, soda, by a little at a time, and examine the mixture after every addition of the alkali, we find for a considerable time it will exhibit the properties of an acid; it will have a sour taste, and convert vegetable blue colours into red; but if we continue to add greater quantities of soda, these acid properties will gradually diminish, and at last disappear altogether. At that point the combination is at an end; it has reached its *maximum* in this case; for if we continue to add more alkali, the mixture will gradually acquire alkaline properties; it will convert blue vegetables into green; it will have a urinous or alkaline taste, &c. These properties will become stronger, the greater the quantity of the soda is which is added.

Again, take muriatic acid, and let fall into it gradually carbonate of lime, or magnesia; an effervescence will take place, for a chemical union ensues between the acid and the lime, or magnesia, and the carbonic acid, and other constituents of these bodie, become disengaged. But if we continue the addition of the lime, or magnesia, until it produces no farther effervescence, no chemical union will be obtained; the lime will fall to the bottom unaltered, for the combination is at its *maximum*.

It is on this account that water can only dissolve a certain quantity of salt; ardent spirit, a certain quantity of resin, &c.

The union of oxygen and hydrogen belongs likewise to this class.

3. Chemical affinity is capable of uniting different bodies in two, three, or more proportions; each of these combinations produces compounds, possessing peculiar properties.

This peculiarity of combination is highly important.

It is owing to this circumstance, that both nature and art produce substances of the same principles, only combined in different proportions, which possess peculiar properties, widely different from each other.

An instance of this law may be seen in the following experiment:—

Introduce one ounce of copper filings into four ounces of muriatic acid, contained in a medicine-phial of eight ounces' capacity; cork it well, and let it stand undisturbed; the acid will soon acquire a greenish colour, which becomes deeper in proportion as the copper becomes dissolved; but in a few days, if the bottle be now and then agitated, the colour vanishes, and the solution at last becomes colourless.

If we now invert the bottle in mercury, or water, and remove the cork under that fluid, a quantity of the mercury will rush in: an evident proof that part of the air contained in the phial has disappeared.

If we examine the remaining air, we shall find that it is incapable of supporting flame, and that it is nearly deprived of all its oxygen. If we now open the phial, the solution becomes again green and colourless as before.

The *rationale* of these phenomena is

this:—The quantity of oxygen which is present in the confined quantity of air in the empty part of the phial, combines with the copper to a certain degree, which then becomes soluble in the acid, and exhibits the green solution.

This oxide is gradually decomposed, more copper is dissolved, and the solution becomes colourless. If more oxygen be admitted, the solution becomes green again as before.

8. The energy of the chemical affinity of different bodies, is modified in proportion to the ponderable quantities of the substances placed within the sphere of action.

It is obvious from this, that the denomination of elective affinity is erroneous; since it supposes the union of one entire substance with another, in preference to a third. But this is not the case; a mere division of action takes place in instances of this kind; that is to say, the substances act according to the quantity existing within the sphere of activity. The excess of quantity is capable of compensating for the deficiency of the force of affinity. When, therefore, a compound body of two substances is acted on by a third, that part of the compound which is the subject of combination is divided between the two remaining, not only in proportion to their respective degrees of affinity, but also according to their ponderable quantities; so that by varying this in either, the effect produced will be varied.

Thus Berthollet has proved, that in all cases a large quantity of a body is capable of abstracting a portion of another, from a small portion of a third, how weak soever the affinity between the first and second of these bodies may be, and how strong soever the affinity between the second and third. Thus potash is capable of abstracting part of the acid from oxalate of lime, phosphate of lime, and carbonate of lime. Soda and lime decompose partially sulphate of potash. Nitric acid subtracts part of the base from oxalate of lime, &c.

The following experiment, advanced by Berthollet, will prove this more clearly.

If equal parts, by weight, of sulphate of barytes and potash, be boiled in a small quantity of water, to dryness, it will be found that the sulphuric acid has been divided between the two bases in the compound ratio of their mass, and their force of affinity. The greater part of the sulphate of barytes will be found undecomposed; a small quantity of barytes will be found at liberty; most of the potash will also be uncombined, but a certain portion will be united with the sulphuric acid which the barytes has lost, in the form of sulphate of potash.

It is not merely in the instance stated here that this division of one body between two others, according to their respective masses and affinities, takes place, there being scarcely any example to the contrary.

And as the affinities of bodies vary with their masses, it is obvious that, when we speak of the affinities of bodies, we ought to consider them as always acting in certain determinate proportions.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, October 19, R. A. Ogilvie, Esq., on the Natural History and Physiology of Birds. Friday, October 21, J. H. Pepper, Esq., on Frictional Electricity. At half-past eight precisely.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Oct. 17, R. A. Ogilvie, Esq., on the Classification and Nomenclature of Birds. At a quarter-past eight o'clock.

QUERIES.

1. How to make a boot-powder to cause the boots to slip on easily? 2 How to clean gilt picture-frames? I am informed there are two descriptions of gilding, the one oil, and the other water-gilding; are they both treated alike in cleaning, and how can you tell the difference? 3. Is bronze a metal in ore, or is it a compound of other metals? If so, of what is it composed, or what is the process of bronzing such as the gates at Buckingham Palace, and also smaller articles, such as chimney ornaments? 4. How to make a composition to put on window-glass so as to appear like ground glass? I have seen counting-house and shop-windows, done over with a composition, sometimes in ornaments, very much resembling ground glass; not common whitening, but more transparent. J. W.

A constant reader wishes to be informed, by what chemical process, printers' ink is to be extracted.

A good recipe for dyeing beaver hats black? D. D.

SIR,—Having tried the usual recipes for the manufacture of ginger beer, by fermenting it with yeast, and finding it will not keep for any length of time; I shall feel obliged if some of your able correspondents will favour me with a form for the same; stating what the article is that the London makers use, whereby they warrant it to keep twelve months; or whether they have any particular method of working it with yeast, which en-

ables it to keep. But I have been given to understand, they do not use yeast. Likewise, through the medium of your valuable work, perhaps some of your subscribers will be able to give me a recipe to make ink to write upon zinc, which will stand the effect of the weather; being required for labels for flowers.

T. C. J.

1. How are blue and red printing-inks made? 2. How is the extract of logwood made? and how many pounds of the chips does it take to produce one pound of the extract? 3. A recipe for making japanner's gold size? 4. A recipe for making the best kind of isinglass size, that will keep for a length of time without spoiling, or losing its glossy properties? 5. Directions for making a mixture to steep seed, wheat, &c. in, previously to sowing, that will prevent smut, blight, and mildew, and that will add a fertilizing property to the seed, and assist its germinating? H. O. P. E.

A short time since, I made an application for harness, shoes, &c., containing glue, isinglass, logwood and vinegar, and a few other articles; but was sorry to find that it had two material defects, which I wish to be remedied, one of which was, that it would not keep for a length of time without spoiling; and the other was, that it would not adhere to the articles on which it was applied in wet or damp weather; but it came off on the hands and clothes, and on the hair of the horses; and I shall feel greatly obliged, if some of your correspondents will inform me of the best way to remedy the defects complained of. I am informed that either bees' wax, shell-lac, or gum-benzoin, would answer the purpose; and shall be glad to know which would be the best way of using them, without injuring the gloss of the other articles; and at the same time to form a mixture that will produce an instant and permanent jet polish? 2. A recipe for making the silent congreve matches—that is, those that will light by friction, without making any cracking noise whatever? 3. How is the oxymuriate of lime made? and which would be the best way to make a solution of it, to extract the colour from small pieces of timber, as oak, pear-tree, mahogany, &c.?

D. E. M. S.

ANSWERS TO QUERIES.

"X. Y. Z." If he is in want of a small lathe, I have one of the following size—viz. 26 inches in the bed, and 3½ in centre; also several tools for turning, and a few chucks, all of which I can let him have for 3*l*. The lathe has an iron fly-wheel two feet diameter.

"T. L. T." Parchment is not used in any part of an organ. The keys are generally made of lime-tree, but good straight-grained pine answers nearly, if not quite, as well.

"W. H." Being very much occupied just at present, I have not sufficient leisure to furnish drawings and working directions to "W. H." for making a seraphine; but if he can wait a few months, I can do so; or should he reside near enough, he can learn my address from the Editor; and if he will call on me, I will show him a seraphine I have made for myself, on an extremely simple construction; and put him in the way of doing the same. The best organ-stops to unite with a seraphine, are the clarabella and flute.

"P. H." A Smee's battery is made as follows:—A piece of thin silver foil is to be made a little rough by scratching it with fine glass-paper, or otherwise, and then platinized by the electrolytic process. As it is no consequence how thin the silver is, it will be better to have it as thin as possible, and support it in a little wooden frame, something like a slate frame. Two sheets of zinc previously amalgamated, are then placed one on each side of the platinized silver; and the zinc plates are connected together by a binding screw. The object in amalgamating the zinc is, to prevent any chemical action on it, by the exciting liquid, as soon as the connexion between the poles is broken. No diaphragm is necessary in this battery; and the exciting liquid should be pure sulphuric acid, diluted with eight times its bulk of water. If the acid be not pure, it destroys the amalgamation of the zinc, and an immense waste occurs. To ascertain the purity of the sulphuric acid, put a little in a test-tube, or Florence flask; add a few drops of sulphate of indigo to give it a blue colour; apply heat until it boils, and keep it in a state of ebullition for about a couple of minutes; then if the blue colour remain, the acid is pure, but if it fliy or be turned brown, nitric acid is present, and it is totally unfit for use in a Smee's battery. It is very rare that the acid can be obtained pure at an oilman's; and none should be used without first testing it. No more of the sulphate of indigo should be used than will give a blue colour; as, if the quantity experimented on be small, it may not contain sufficient nitric acid to act on the whole of the indigo, but quite enough to destroy your battery. The amalgamation is performed as follows:—Place a little mercury in a small saucer, and cover it with pure dilute sulphuric acid, and brush it over the zinc until a bright metallic coating is obtained. G. S., Jun.

TO CORRESPONDENTS.

J. S. *can register his invention, which will secure it for twelve months, and will cost about twenty shillings. It can afterwards be patented.*

J. Jenkins. *If he will favour us with his address, we will forward a letter which we have received, description of the electrical machine, &c., he wishes to purchase.*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

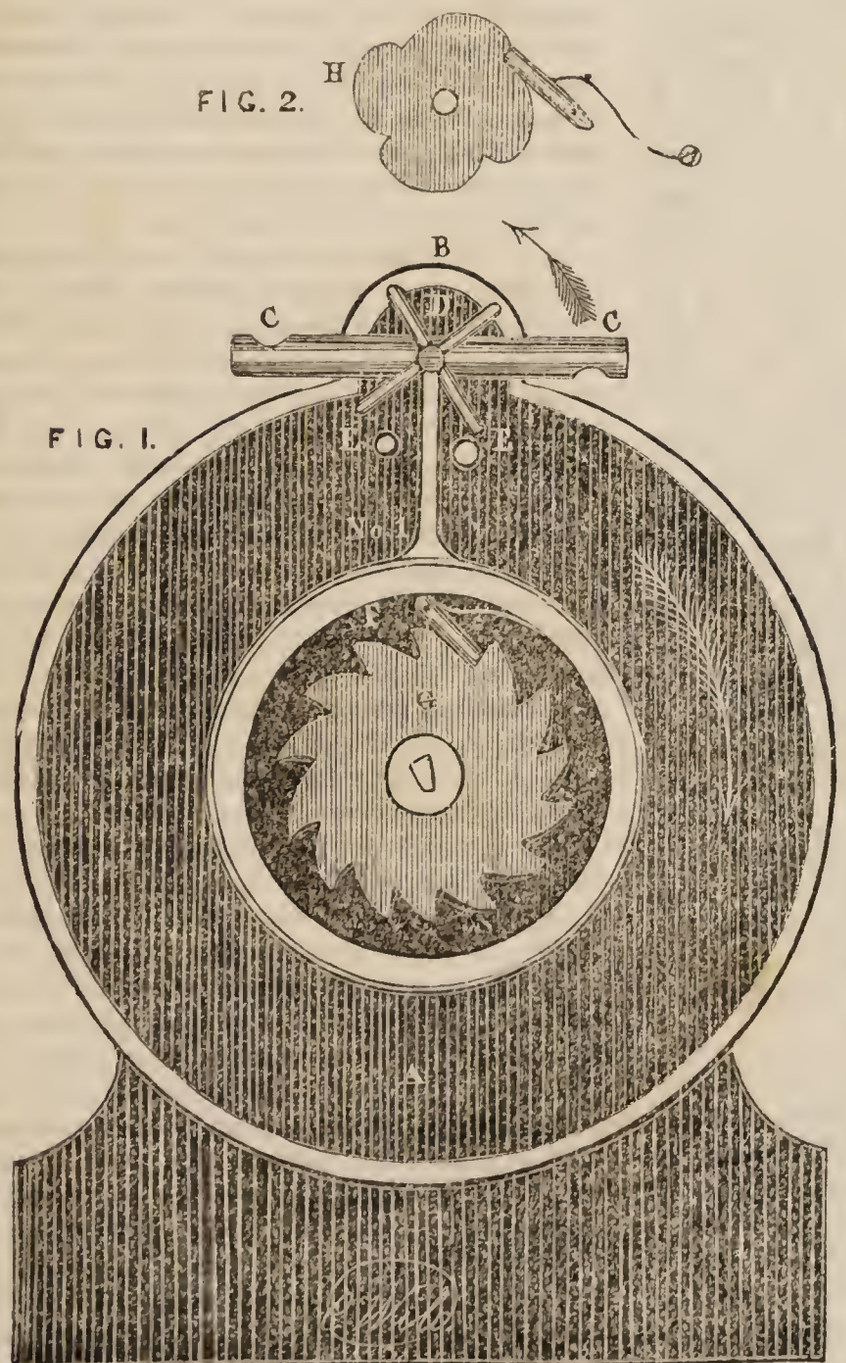
THE PENNY MECHANIC

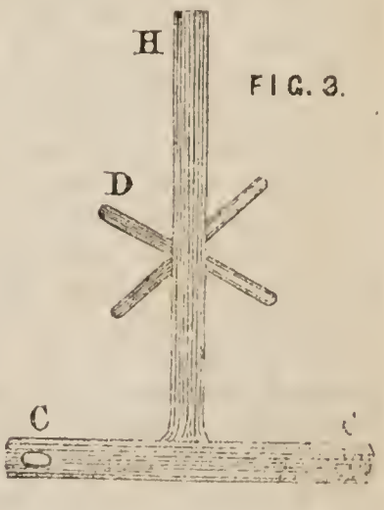
AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 106, THIRD SERIES. | SATURDAY, OCT. 22, 1842. | No. 354, OLD SERIES.

WALTER'S ROTARY ENGINE.





Vol. VIII.—No. 47.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

WALTER'S ROTARY ENGINE.

Sir,—I have invented a plan for a rotary steam-engine, which, if you think it worthy of a place in your columns, you will be kind enough to insert. A brief outline of my plan will be sufficient to be understood. As this subject still occupies the attention of scientific men, I have no doubt that any plan differing from another, with a view to improvement, will be acceptable to your readers.

Fig. 1 represents the interior part of the engine; A shows the case of the engine, for a circular piston to revolve; B shows a narrow case, connected with the interior of the engine. C C is the piston-propeller, a hollow tube with a hole at each end, where steam issues out, and causes it to revolve in the direction of the arrow. D is four levers moving with C C, for retaining and moving forward the piston. No. 1, E, to the left, is an orifice where the steam issues out; E, to the right, is where the steam enters; F is a hollow side wheel revolving with the piston, with a spring latch attached. G is a cog-wheel revolving with a spindle, which is the outward moving force. H, in fig. 2, is a wheel revolving with a spring latch on the end of the tube in fig. 3. Fig. 4 is the other side wheel with piston 2. The working effect of this plan is thus:—Steam is admitted in the opening, E, which forces the piston No. 2, and moves the lever, D, which causes steam to be admitted in the tube, C C, and propels piston No. 1 forward, leaving piston No. 2 in its place. The feed pipe is E to the right, where the end of the tube, H, is connected for supplying both with steam; it is intended to have two valves for supplying the two, C, acting together, one open and the other shut. These valves communicate with the wheel, H, by a lever opening and shutting as the spring latch rises and falls. A good engine made after the above plan, will act with regularity and precision.

Yours &c.,

S. Walter.

SHIP BUILDING.

A most ingenious model has fallen under our observation, of which Captain Drew (the destroyer of the piratical Caroline) is the inventor, for strengthening ships of war, so as to make it all but impossible they shall become hagged. To steam-vessels of the larger class, the adoption of this simple and comparatively inexpensive machinery will prove of most vital importance. The immense weight of the engines requisite for a steam-ship, render her more than ordinarily liable to break amidships. Captain Drew's plan was, we are told, suggested by the ingenious and admirably effective operation lately performed on the Penelope.

The grand feature of his project is, to relieve a steam-vessel from the vast weight of machinery amidships, and to throw it upon two distant parts of the ship, much more capable of sustaining it; and, if there be any one vessel to which such an adjunct will be more especially necessary than another, it is the Penelope, whose machinery will be placed exactly in the space occupied by the sixty feet of timber, which remains to be added to its length. Captain Drew's plan consists of two longitudinal pieces of timber firmly nutted together, constructed on something like the principle of the arch of a bridge, which will be capable of bearing an immense weight. These bearers are to be covered by a platform, for the machinery, of four-inch plank; so that the strongest part of the vessel will in future be that which has hitherto proved the weakest.

It is well known that the unfortunate President was broken-backed before she left the British Channel, on her last trip, from the immense weight of the machinery amidships, the undoubted cause of her melancholy catastrophe. The owners of the British Queen are, we are told, about to cut her in two for the purpose of avoiding a similar catastrophe; and it is well known that the long steam-vessels running in Canada, seldom last more than five or six years, from the same cause. If, therefore, Captain Drew's plan should realize the expectations we have formed of it, it cannot fail of proving of most vital importance to the navy at large, and to steam-ships in particular.

We had almost forgotten to notice another important advantage—its elasticity—that will greatly obviate that constant jar, which is so trying to the timbers of a steam-ship, and so inconvenient to its occupants. We have the greater pleasure in speaking of this invention as we think it deserves; inasmuch, as we have understood that Captain Drew has no interested motive in placing it before the public. He seeks no patent, and desires no reward, beyond the credit of being instrumental in preserving, not only valuable property, but human life, from destruction. We need hardly add, that this is precisely the sort of projector in whose inventions we are inclined to repose the greatest confidence.—*United Service Gazette.*

MANAGEMENT OF BEES.

THE following extract has been sent to us, as an answer to a query in a former Number. It is taken from a local paper, and will, no doubt, prove interesting to our readers.—ED.

"I fear that most persons who keep bees, have already proceeded to "*put them down*," or, as it is termed in some countries, to "*take them up*"—that is, to destroy them with brimstone. Should there be any, however, who yet possess weak stocks, and who are in doubt whether, with the provision which they have, they will live through the winter, allow me to advise them to take the comb and honey from such stocks, and transfer the bees to other hives. This plan will be attended, in the first place, with an immediate gain of honey—it being an ascertained fact, that two stocks of bees, when put together in one hive, will not consume much above *one-half* the quantity of honey which they would consume if kept separate. By keeping two stocks of bees, therefore, separate, if one hive will contain them both, persons are actually wasting honey. Another advantage from this plan is that, if two or three stocks of bees are put together in one hive, there will be *earlier* and *stronger swarms*, when the season for swarming arrives. The consequence of this, I need not say, will be the amassing a much larger quantity of honey in the following summer. This will be the result in a common way. If, however, the following season turn out to be a particularly good honey season, there will be so many additional thousands of bees to collect that which would otherwise be lost, if the bees were destroyed. Bees only live one year, and those remaining in a hive in the autumn, are always such as were bred during the summer, and intended to do all the work of the succeeding spring; to destroy them, therefore, is a wanton and unnecessary waste of property.

"Perhaps some persons may smile at the idea of taking the honey without killing the bees, and declare that it is impossible. In reply, I assert that it is not only possible, but *perfectly easy*, and attended with as little—if not indeed often with less—trouble than killing them. The operation is performed in a very few minutes;* and, if done with care, scarcely a single bee need be lost. Within these two or three weeks past, I have shown some cottagers how to do it, who are really delighted with the plan, seeing how practicable and easy it is. I have taken away the honey and comb from fourteen hives, and transferred the bees to other hives; and the bees thus united, are as quiet and peaceable as if they had always been together.

"The plan I have adopted is the following:—At the proper season—that is, in autumn, before they were fully ripe—I picked up three or four fuzz or puff-balls (a kind of large fungus or mushroom growing in the meadows); these I compressed a little, and then had them thoroughly dried in an oven, after the bread had been taken out. I kept them in a dry state till I wanted them. I had also a round box made of thick tin (without any solder), with a top full of holes to take off; the diameter of the box is about two inches, and its depth about an inch and a half; the top is about an inch and a half in height, ending in a point: at the bottom of the box are three holes. The box and fuzz-ball being ready, I took an empty hive—as nearly as possible of the same size as that from which I intended to take the bees—turned it bottom upwards, and placed it in a pail. I then cut a stick sharp at one end, and fixed the other end in the middle hole at the bottom of the tin box; having done this, I cut off a piece of the fuzz-ball, about double the size of a hen's egg, lighted it in the fire, placed it in the box, put on the lid, fixed the sharp end of the stick in the bottom of the empty hive as it stood in the pail, and then immediately put upon the empty hive the hive from which I intended to take the bees, placing a wet cloth round the two hives (where they joined) to prevent any smoke from getting out. In about a minute the bees began to drop, just as if peas or heavy drops of rain were falling; soon after this, I tapped the top of the full hive several times to make them fall faster; in a short time the dropping ceased. I then took off the cloth, and found all the bees lying still and quiet in the bottom hive, except perhaps a few which remained sticking to the combs or in the cells. I then turned out the bees upon a table, found the queen, and placed her in safe keeping under a glass; supplying her afterwards with a little honey on a small piece of comb. Having so done, I swept the bees back into the empty hive with a feather, and placed the hive again in the pail as before. I then sprinkled them freely with a thick syrup made of sugar and ale, boiled a minute or two, and placed upon the empty hive containing the stupified bees the other hive with which I intended to unite them, pinning a cloth round them so close as to prevent any opening for a

* It may be done any time during the day, if the hives are only stopped overnight.

bee to escape. I next put them by in a place where no accident could happen to them by being thrown down, &c., and let them stand till about ten o'clock the following night, or the night after the following night, when I brought them quietly out, unpinned the cloth, and placed the top hive immediately on the spot from whence it had been before taken, and left them; this completed the operation, and it has answered in all the fourteen cases I have referred to. In three instances I have put two stocks of bees to a third, thus having in a single hive three quantities of bees.

"It is better, I think (though I do not say that it is absolutely necessary), to take the queen away; it avoids all risk of disagreement, and she is easily found by looking out sharply; she is longer, more taper, and has shorter wings than common bees. I generally find her by stirring the bees about with a quill, if she cannot be observed at once. If persons choose to sacrifice the few bees which remain in the combs they can, and this will shorten the operation; but there is generally time enough to take them all out before the stupified bees return to activity. It is important not to forget to sprinkle the stupified bees with the syrup of ale and sugar, as its scent attracts the bees down from the full hive; smelling that, they will soon go down, and commence licking the sprinkled bees clean. They thus get intermingled, and afterwards all go quietly up the top hive, as if they had always been one family.

"If any person choose to try the plan, the puff-balls will do, if dried, as I have before pointed out. If, however, none can be obtained, a substitute may be found described in *Taylor's Beekeeper's Manual*, price 4*s*. published by Groombridge, London. It is better to preserve the captured queen as long as she will live, in case of an accident to the other; she generally lives about three or four days. When I teach a cottager or farmer the plan, I extract a promise that he will again teach it to others. The month of September is the best time of the year.

"Should these observations prove the means of leading any persons interested in bees to save their own, and of teaching so useful a plan to cottagers, I shall be most happy."

HISTORY OF MEDALS.

(Continued from page 365.)

Forgeries of modern coins and medals, Mr. Pinkerton observes, are almost as numerous as of the ancient. The satiric coin of Louis XII. Perdam Babylonis nomen, is a remarkable instance: the false coin is larger than the true, and bears the date 1512. The rude coins of the middle age are very easily forged, and forgeries have accordingly become common. Forged coins of Alfred and other early princes of England have appeared, some of which have been done with great art. "The two noted English pennies of Rich. I. (says our author) are of this stamp; and yet have imposed upon Messrs. Folkes and Snelling, who have published them as genuine in the two best books upon English coins. But they were fabricated by a Mr. White of Newgate Street, a noted collector, who contaminated an otherwise fair character by such practices. Such forgeries, though easy, require a skill in the history and coinage of the times, which luckily can hardly fall to the lot of a common Jew or mechanic forger. But the practice is detestable, were no gain proposed: and they who stoop to it must suppose, that to embarrass the path of any science with forgery and futility, implies no infamy. In forgeries of ancient coin, the fiction is perhaps sufficiently atoned for by the vast skill required; and the artist may plausibly allege, that his intention was not to deceive, but to excite his utmost powers, by an attempt to rival the ancient masters. But no possible apology can be made for forging the rude money of more modern times. The crime is certainly greater than that which leads the common coiners to the gallows; inasmuch as it is committed with more ease, and the profit is incomparably larger."

All ancient coins and medals, though equally genuine, are not equally valuable. In medals as well as in everything else, the scarcity of a coin stamps a value upon it which cannot otherwise be derived from its intrinsic worth. There are four or five degrees of rarity reckoned up; the highest of which is called *unique*. The cause is generally ascribed to the fewness of number thrown off originally, or to their having been called in, and recoined in another form. To the former cause Mr. Pinkerton ascribes the scarcity of the copper of Otho and the gold of Pescennius Niger; to the latter that of the coinage of Caligula; "though this last (says he) is not of singular rarity; which shows that even the power of the Roman senate could not annihilate an established money; and that the first cause of rarity, arising from the small quantity originally struck, ought to be regarded as the principal."

In the ancient cities Mr. Pinkerton

ascribes the scarcity of coin to the poverty or smallness of the state; but the scarcity of ancient regal and imperial coins arises principally from the shortness of the reign; and sometimes from the superabundance of money before, which rendered it almost unnecessary to coin any money during the reign of the prince. An example of this we have in the scarcity of the shillings of George III. which shows that shortness of reign does not always occasion a scarcity of coin: and thus the coins of Harold II. who did not reign a year, are very numerous, while those of Richard I. who reigned ten, are almost unique.

Sometimes the rarest coins lose their value, and become common. This our author ascribes to the high price given for them, which tempts the possessors to bring them to market; but chiefly to the discovering of hoards of them. The former cause took place with Queen Anne's farthings, some of which formerly sold at five guineas; nay, if we could believe the newspapers, one of them was, some years ago, sold for 96*l.* The latter with the coins of Canute, the Danish King of England; which were very rare till a hoard of them was discovered in the Orkneys. As discoveries of this kind, however, produce a temporary plenty, so when they are dispersed, the former scarcity returns; while, on the other hand, some of the common coins become rare through the mere circumstance of neglect.

As double the number of copper coins of Greek cities are to be met with that there are of silver, the latter are of consequence much more esteemed; but the reverse is the case with those of the Greek princes. All the Greek civic coins of silver are very rare, excepting those of Athens, Corinth, Messana, Dyrrhachium, Massilia, Syracuse, and some others. Of the Greek monarchic coins, the most rare are the tetradrachms of the Kings of Syria, the Ptolemies, the sovereigns of Macedon and Bithynia, excepting those of Alexander the Great and Lysimachus. Those of the Kings of Cappadocia are of a small size, and scarcely to be met with. Of those of Numidia and Mauritania, the coins of Juba, the father, are common; but those of the son, and nephew Ptolemy, scarce. Coins of the Kings of Sicily, Parthia, and Judea, are rare; the last very much so. We meet with no coins of the Kings of Arabia and Comagene except in brass; those of the Kings of Bosphorus are in electrum, and a few in brass, but all of them rare; as are likewise those of Philetenis King of Pergamus, and of the Kings of Pontus. In the year 1777, a coin of Mithridates sold for 25*l.* 5*s.* Didrachms of all kings and cities are scarce, excepting those of Corinth and her colonies; but the gold coins of Philip of Macedon, Alexander the Great, and Lysimachus, as has already been observed, are common. The silver tetradrachms of all kings bear a very high price. The didrachm of Alexander the Great is one of the scarcest of the smaller Greek silver coins; some of the other princes are not uncommon.

In most cases the copper money of Greek monarchs is scarce; but that of Hiero I. of Syracuse is uncommonly plentiful, as well as that of several of the Ptolemies.

The most rare of the consular Roman coins are those restored by Trajan: of the others the gold consular coins are the most rare, and the silver the most common; excepting the coin of Brutus with the cap of liberty, already mentioned, with some others. Some of the Roman imperial coins are very scarce, particularly those of Otho in brass; nor indeed does he occur at all on any coin struck at Rome: but the reason of this may, with great probability, be supposed to have been the shortness of his reign. His portrait upon the brass coins of Egypt and Antioch is very bad: as well as almost all the other imperial coins of Greek cities. The best likeness is on his gold and silver coins; the latter of which are very common. The Greek and Egyptian coins are all of small or middling sizes, and have reverses of various kinds: those of Antioch have Latin legends, as well as most of the imperial coins of Antioch. They have no other reverse but the SC in a wreath; excepting in one instance or two of the large and middle brass, where the inscriptions are in Greek. Latin coins of Otho in brass, with figures on the reverse, are certainly false; though in the cabinet of D'Ennery at Paris there was an Otho in middle brass restored by Titus, which was esteemed genuine by connoisseurs.

The leaden coins of Rome are very scarce. Most of them are pieces struck or cast on occasion of the saturnalia; others are tickets for festivals and exhibitions, both private and public. The common tickets for theatres were made of lead, as were the *contorniati;* perpetual tickets, like the English silver tickets for the opera. Leaden medallions are also found below the foundations of pillars and other public buildings, in order to perpetuate the memory of the founders. From the time of Augustus also we find, that leaden seals were used. The work of Ticorini upon this subject, entitled *Piombi Antiochi*, is much recommended by Mr. Pinkerton.

MISCELLANEA.

Cement for Damp Walls.—Boil two quarts of tar with two oz. of kitchen grease for a quarter of an hour in an iron pot; add some of this to a mixture of slaked-lime and powdered glass, which has passed through a flour sieve, and been carefully dried over the fire in an iron pot, in the proportion of two parts of lime to one of glass, till the mixture becomes of the consistence of thick plaster. This cement must be used immediately after being mixed, and therefore no more of it should be mixed at a time, than will cover one square foot; since it quickly becomes too hard for use, and continues to increase in hardness for three weeks. Great care must be taken to prevent any moisture from mixing with the cement.

For a wall which is merely damp, it will be sufficient to lay on one coating of the cement about one-eighth of an inch thick. But should the wall be more than damp or wet, it will be necessary to coat it a second time. Plaster made of lime, hair, and plaster of Paris, may be afterwards laid on the cement. This cement when put in water, will suffer neither an increase nor diminution in its weight; and it has the peculiar advantage of joining Portland stone, or marble, so as to make them as durable as they were prior to the fracture.

School of Design, Paris.—At this dull season of the year, when the exposition at the Louvre is closed, and but few works of art are publicly exhibited, the attention of the amateurs has been, for the last week, anxiously directed to the award of the Academy, for the best painting produced by an *élevé* of that school—an award which at once places the successful artist in the high road to fortune and fame. The circumstances attending this honourable competition, are exceedingly interesting and worthy of imitation in any country which professes to encourage the superior arts. At a certain period of every year, such pupils as from their abilities are entitled to become candidates *pour entre en loges*—that is to say, for admission within *the box or lodge*—enrol their names to abide the usual ordeal, which is as follows:—On the morning of the day appointed for trial by the directors of the school, the registered candidates (whose ages severally must not be under eighteen, nor above thirty) are each introduced into the small apartment denominated the *loge*. Here every requisite is provided for their use, and a *carte*, or programme, informs the artist, for the first time, of the subject upon which he is required to compose a rough draft of the intended picture. No person is, on any pretence whatever, admitted to the pupil, nor is he permitted to leave the lodge until sunset. When the hour of liberation arrives, the several sketches are then submitted to the directors; and from these numerous designs, such only as are approved of are allowed to be finished *in large*, the original sketch forming, without the slightest deviation, the model for the picture. The addition of a single figure, or even a head, would be sufficient to cause the total expulsion of the pupil from the school. When the period allowed for the completion of the pictures has arrived, they are, one and all, submitted to the inspection of the directors, who usually select ten or twelve, the most worthy, and from these—which, during the momentous interval, are exhibited for a few days to the public—the first and second grand prizes are selected, and a third, which is merely noted "for honourable mention." The artist whose genius has elevated him to this distinction, is sent to Rome at the expense of Government, there to study for five years, with an annual pension of 2100 francs; but this liberal provision is not without an obligation on the part of the student, to send home every year (for the first four) an original painting, or a copy from one of the old masters; and, on the fifth year, a grand picture, either completed or in progress. The works of the pupils which adorn the walls of the Academy, do honour to the French School of Design; and their improvement in the department of colouring, is apparent in the two principal productions of the present year. The subject chosen, is the anointing of the youthful David by Samuel. The incident of the story is poetical, and the manner in which the different minds have treated the same event, gives additional interest to the spectator. In the first prize, the venerable prophet, wholly occupied by the act which he is commanded to perform, quietly fulfils the ordination of the Lord, and pours from the sacred horn the oil which anoints the humble shepherd boy a King of Israel. The next in design is more spirited. There the aged Samuel, with uplifted hands and eyes, implores a benediction on his son, while mechanically, as it were, his hand performs the sacred rite of anointing the future king. The third painting is good in design, but far inferior to the two first, which have met with encomium. Altogether, I have never visited a gallery of painting with more lively interest or gratification, than

hat of the late exhibition at the Palaceof he *Beaux Arts*.

The Deptford Pier, upon which 60,000*l*. ias been spent, was knocked down at the Auction Mart, on Wednesday, to Mr. Timothy Tyrrell for 50*l*. It has 600 feet of frontage, and about as much depth. Mr. Tyrrell had lent the concern 13,000*l*., and another party had lent it 10,000*l*. Assuming it was, *bonâ fide*, a fair sale, what becomes of the poor shareholders? Fifty pounds for a concern on which 60,000*l*. had been laid out!!! Surely, if the directors did not by mistake lay the money in their own pockets instead of on the concern, it is worth more than that. There must be some mistake,—the auctioneer must have understood 5,000*l*. at the very least.—*Railway Magazine*.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, October 26, Mrs. C. L. Balfour, on Perseverance. Friday, October 28, T. Williams, Esq., on the Organs of Support and Locomotion in Man and the lower Animals. At half-past eight precisely.

Mutual Instruction Society, 16, Great Tower Street; City.—Monday, Oct. 21, Dr. Bowkett, on the Element Iodine, and its application as a Medicine. At a quarter-past eight o'clock.

QUERIES.

1. The process by which hand-saw files are made, cut, and tempered? 2. A receipt for making the best kind of paste blacking, equal to that made by Everitt, Warren, or Day and Martin? 3. The best method of cleaning buckskin breeches, so as to give them the appearance of new? 4. Directions for making the best kinds of carmine and ultramarine? 5. The simplest method of drawing an oval of any length or breadth that may be required? and also the simplest and most correct method of dividing the circumference of a circular piece of board or metal, into five, seven, or nine, equal parts? N. M. T.

"Fabier" will confer a favour by explaining his method of *shrinking* an iron mortice on a bar, so as to insure a correct fit; I allude to his reply to "X. Y. Z." inserted in No. 103.

I shall be obliged by being informed where I can purchase diamond or ruby dust, or tools having points of diamond or ruby, for turning hardened steel, and the price of the same. AN AMATEUR MECHANIC.

I should be much obliged if "Mr. J. R. Bilbrough" will favour me with the description of the manner in which the slide he describes in No. 20 (April 30,) of your valuable work, is suddenly shifted by the piston. J. D.

The best fluxes for gold and silver? M. K.

Are pedomotive carriages liable to pay the tolls on the turnpike road, or are they liable to be taxed as private carriages? W. F. A.

1. What is the cheapest article, and the method of using it, for purifying catgut-manufactories, and other similar places? 2. The best method of staining white or light coloured cucumbers, in imitation of the natural green colour and gloss, which they have before they are removed from the forcing frame? 3. Directions for making a composition for applying to coach-tops and harness, that will produce a brilliant and durable jet polish? 4. How to test the gold and silver coins of Great Britain, without discolouring or otherwise injuring them? 5. The best method of cleaning, and restoring to their original colour, the laps of hunters' scarlet coats that have been discoloured by the perspiration of the horses? 6. The quickest and cheapest means of softening old hard putty on sash-windows, skylights, &c., so as to be easily scraped off with a knife? PHILOMELA.

The process of polishing and browning gun-barrels, and whether the muriatic or nitric acid is to be diluted? J. W. R.

The best mode of preparing a dye and mordaunt to dye feathers a fine scarlet? 2. A preparation to prevent Dutch metal from tarnishing on paper? J. G.

ANSWERS TO QUERIES.

The prices of slide-rest I quoted in Part 69, p. 297, were copied from Holtzapffel's Catalogue; consequently, if there be any mistake, it is theirs, not mine. However, with submission, I must remind your correspondent, that the parts of a slide-rest require the most accurate workmanship; being first planed, and then finished by scraping—operations which add materially to the expense. The slide-rest figured in the "Dictionary of Arts and Sciences," by W. Francis, is, I apprehend, taken from one of Holtzapffel's, and such a one would cost the sum I have specified, varying of course according to size. But if a slide-rest be expensive, a circular-rest is much more so; the price asked by the house above mentioned, being forty-five pounds. A simple fact that proves more forcibly than any arguments I could adduce, the necessity of much less complicated apparatus for the lathe, and such as is calculated to come within the resources of the practical mechanic.

"J. Couchman." A fly-wheel is well and succinctly described in "Francis' Dictionary of the Arts and Sciences," as "a large heavy wheel attached to machinery to equalize its motion. Its action being to collect the surplus power of the machine, when it can be spared, and to apply this collected power, when afterwards wanted. For example: in

the working of a crank, it has no power to turn the axle of the wheel, when it arrives at certain points (which are called in technical language, the *dead centres*). Here, therefore, it would stop, but the momentum of the fly-wheel carries it beyond these points, when the crank acts by its own power (or more correctly speaking, by its leverage) again." This definition in general terms, may serve to answer the query. It is by no means sufficiently precise in a mechanical sense, and I should recommend "J. Couchman" to refer to the early volumes of the PENNY MECHANIC, where, I mistake not, this difficult, but interesting subject is ably elucidated. I allude more particularly to the theory of the crank.

AN AMATEUR MECHANIC.

"S. E." shall shortly have a paper on the copula of organs—that is, the method of connecting the pedals with the keys, or one row with another at pleasure. G. S., Jun.

SIR,—Having much pressing business on hand, your very clever correspondent "An Amateur Mechanic," must excuse my giving a plan, through the MECHANIC AND CHEMIST, of my notions of the surface lathe at present. It may not be uninteresting to observe, that I have just succeeded in an experiment of vast importance to bell-hangers—that is, by causing a bell to ring without cranks or wires, at any distance; it precludes the necessity of boring holes through the walls, a thing that is often found very troublesome, and not less costly; but, although I know nothing of that business myself, yet I have ascertained that the price varies from 9d. to 2s. per foot, according to the nature of the undertaking; whereas, my system will not cost more than three farthings or one penny per foot, no matter what the construction or complication of the building. G. LODGE.

In perusing some of your back Numbers, I found a query in No. 91, signed "J. W.;" on which I wish to make the following remarks:—In the first place, it must be undoubtedly acknowledged, that an assemblage of people in any room—be it a ballroom or private—render the air they breathe very unhealthy. The very perspiration alone of each person, imparts a gaseous odour, which cannot fail to be the case, either in winter or summer, at any assembly. This noxious gas then is breathed by every one present; and it is my opinion, that it is this gas that, combined with the warm breath, that renders the air still more foul, is the cause of the extension of disease or illness. It is to be greatly regretted, at all places of public amusement, and also our factories, there is a great want of ventilation. Now as "J. W." says, if the fumes of tobacco be introduced into this air already impregnated with foul vapour, does it rectify it or purify it from infection? We must first look to the article itself, and decide if alone it be a benefit. Some accounts I have read, state that in this country, as well as the warm climates of India, there are small insects constantly creating in the walls and rooms of houses; and so minute are some of these insects, that they are not perceptible to the eye without a microscope; and while a quantity of these insects are living in rooms of inhabited houses, it must render the air unhealthy and the place uncleanly; but that since the introduction of the use of tobacco in this country, it has caused the reduction of these insects by the general use of its fumes used as recreation by each householder. This plant is very essential in many medical cases; the fumes of this plant used in a room where fever exists, destroy the infectious air; it is also used largely by our surgical students, while pursuing their anatomical studies over bodies, which at most times are in a state of putrefaction; and it is here used to destroy infection; so that I think upon the whole in favour of the plant, it may be said to render the air in large assemblages of people, more pure and less infectious. In short, the fumes of this plant may be said to preserve health, destroy insects and infection, as well as being a comfort to the pastime of man. MANILLA.

TO CORRESPONDENTS.

We shall be glad to receive G. S. Jun.'s drawings on the Copula of Organs.

J. W. *It is impossible to remove grease from paper so as to leave the surface quite clean.*

R. S. *The address of the party is No. 9, Upper St. Martin's Lane.*

J. Sinkins. *We have received a note for him from a gentleman respecting an electrical machine, which he can have by applying at our office; or the address of the party is, S. A. J., 38, Lamb's Conduit Street.*

In our last No., in the notices to correspondents, J. Jenkins should be J. Sinkins.

Mechanicus. *We thank him for his good wishes, and for the kind interest he takes in the sale of our Magazine; but we are compelled to decline inserting his paper. It is not at all suited to the pages of the* MECHANIC. *If his other communications are original, we shall be most happy to insert them.*

Inventicus. 1*st. We do not think his plan as it is at present drawn out, would quite succeed. He has, however, some excellent ideas; and as the subject is one which offers a very large scope for talent, we advise him by all means, to prosecute his studies thereon.* 2*nd. An infallible method of measuring the human figure, and of taking exact and accurate proportions, has, we believe, never yet been discovered. We are not much acquainted with the art of tailoring, but have been told, that an instrument for ascertaining the proportions of every variety of shape in the human figure, would be a most important desideratum to that trade.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid; published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

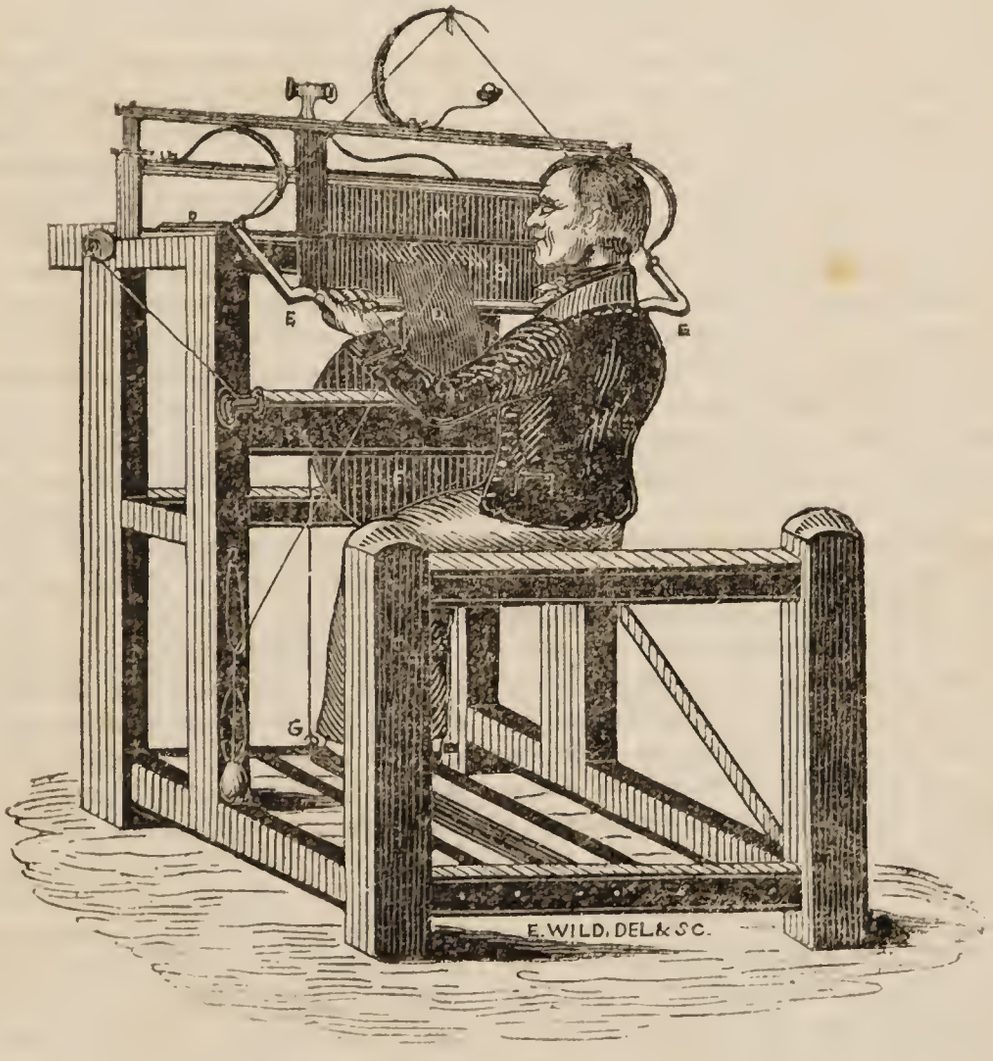
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 107, THIRD SERIES. | SATURDAY, OCT. 29, 1842. | No. 355, OLD SERIES.

THE STOCKING-FRAME.



Vol. VIII.—No 48.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

THE STOCKING-FRAME

(See Engraving, front page)

Was invented by a clergyman named Lee, of Woodborough, a small village six miles from Nottingham, under the following circumstances:—He courted a damsel in this village, and, whenever he went to see her, she paid more attention to her knitting than to his addresses; he therefore determined to invent a machine to supersede knitting, and the engraving is a faithful representation of his machine for weaving instead of knitting stockings.

A, the jacks; B, sinkers; C, needles; D, stocking; E E, presser bar; F, traverse wheel; G, treadles.

INTERESTING INVENTIONS.

An apparatus has been invented by a Frenchman, named Clement, for ascertaining the speed of vessels, determining the heat of the water in boilers, and enabling navigators to discover when they are within fifteen miles of an iceberg, and furnishing a sure indicator of all sudden changes from deep to shallow water. The first is named the "Sillometer," a title given to a substitute for the common log, and consists of a hollow copper ball, against which the water acts, attached to a move able plug of the same metal, which slides in a copper tube, passing through the centre of the vessel to the keel; to this plug is attached a lever, which, by means of a vertical rod, acts on a second lever placed on the deck of the vessel, and communicating with a spring; the tension of the spring constitutes an equilibrium with the pressure of the water on the ball, and serves to measure the rate at which the ship is moving, by means of a hand, the movements of which on a graduated dial indicate, at every moment, not only the speed of the ship, but also the distance run in any given time. The sillometer appears to be an ingeniously constructed instrument, and promises to be of great practical value. It offers also the advantage of measuring, when at anchor, the force of the currents on the keel of the vessel. The second invention consists of an instrument which indicates constantly the elasticity of the steam, both in high and low-pressure engines, and the level of the water in the boilers. The third invention of Monsieur Clement is a submarine thermometer, which will indicate matters mentioned above.

"We have been much gratified with the inspection of three instruments fitted on board the *Lightning*, Admiralty steam-vessel.

"1st, a Marine Thermometer. This is a very elegant invention, consisting of a spiral vertical spring, permanently fixed through a hole in the bottom of the ship. The peculiarity of the spring is, that it is composed of two metals, platina and silver united. These metals are differently affected by heat and cold; *i. e.* the one expands or contracts more than the other—hence in any variation of temperature, the above-named difference in the nature of the two metals causes the spring slightly to revolve, which motion is communicated to a vertical axis ascending to the quarter-deck, and the axis being attached to an index (like the hand of a watch), shows, on a graduated dial-plate, the most minute alteration in the temperature of the sea.

"The use of this instrument will be obvious to professional men; because as the temperature of the sea decreases in a shallow water, we are thereby warned of the proximity of land. It is, moreover, of importance in order to avoid icebergs. The fate of the unfortunate *President* will be in the recollection of our readers, it being probable that that ship foundered in consequence of running foul of ice.

"The second instrument is a steam-engine indicator. It is constructed on very similar principles to the thermometer, but, instead of communicating with the sea, it is connected by a tube to the boiler of the steam-engine. It has an index and a dial-plate, like the thermometer, and its chief use is (besides its extreme accuracy), that the commanding officer is rendered independent of the engineer; for, while attending to duty on deck, he has only to look at the indicator, and he will then see whether the steam is sufficiently "up," and therefore whether the engineer is doing his duty.

"The third instrument is called a "Sillometer;" its use is to tell the exact velocity of the ship, or, if at anchor, the velocity of the tide. Hence it supersedes the necessity of heaving the log. It is thus constructed:—A hole is made through the bottom of the ship at the side of the keel amidships. Through this hole a copper ball (about five inches in diameter), is hung just below the bilge of the ship; a small vertical copper bar is fixed to this ball, and to this vertical bar is attached a horizontal bar; and again, to the horizontal bar is connected a long chain leading up to the deck of the ship; lastly, to the upper end of the chain is attached another lever, which by a simple apparatus is connected with an index attached to a dial-plate. Now, it is evident, that the greater the velocity of the ship, the great-

er is the pressure of the ball, and hence the greater is the tension on the vertical chain; and hence also the index will move through a greater space in the circumference of the dial-plate. We thus judge of the speed of the vessel.

"We do not pretend to have given more than a mere outline of the construction of the instruments; and we understand that the inventor has taken out a patent for them; and that there are about twenty-eight of them at present in use in the French Navy. If from experience, they are found to answer the end designed, we think M. Clement will have conferred great benefit both to the Royal and Mercantile Navies, and we wish him success in his scientific enterprise."—*Hampshire Telegraph.*

CURVILINEAR TURNING.

To the Editor of the Penny Mechanic and Chemist.

Sir,—With a view to simplify curvilinear turning, and render this beautiful branch of the art available to the workman, my attention has lately been directed to an attempt to give to the compound slide-rest a circular movement throughout the entire circle. I should premise, that it is absolutely essential, that the centre of rotation of the rest be in a line exactly perpendicular to the axis of the mandril, supposed to be prolonged. A toothed wheel fixed under the base-plate of the rest (whether mounted on a bed or a bar is immaterial), and communicating with the lower slide, is usually adopted; this wheel is worked by an endless screw, and acts as a centre, on which this slide, and with it the whole of the rest, revolves. This arrangement is unexceptionable in all cases which come within its radius; but, unfortunately, it is not applicable to small work, unless the lower slide be removed, and a shorter one used. To render my meaning more intelligible, suppose the radius of the lathe to be six inches, this will require that the length of this slide shall be at least equal to it; but an inch more would not be too long for general purposes. Consequently, a slide of six inches radius, would describe a circle of twelve inches diameter; or, in other words, the right-hand or moveable puppet could not be brought nearer to the nose of the mandril than this distance—a condition which evidently precludes its adoption for small work, spheres, balls, &c. if suspended on centres. I have so contrived my lathe, that the cylindrical head of the moveable puppet projects nearly four inches in front: this, added to the length of the outside screw of the mandril, gives me about six inches; yet it is extremely inconvenient to perform curvilinear turning with a radius of that extent. I have submitted this hasty, and, I fear, imperfect description to the readers of the Penny Mechanic, in the hope that some one may be able and willing to assist me in my difficulty. Another point connected with the lathe, I consider worthy of attention: it is this—we are in the habit—why, I know not, except from custom—to employ a screw on the nose of the mandril, to attach chucks to the same. This, to say the least of it, is a troublesome and expensive method; because every lathe requires that its set of chucks be turned on its own mandril. Now manufacturers find this extremely inconvenient, and a useless accumulation of tools; but where the eccentric and other costly chucks are required, the outlay assumes a serious character. I am therefore induced to call the attention of your ingenious readers to these facts, and to solicit their aid. Two things are primarily and absolutely needful, whatever arrangement be proposed. The chuck must be firmly, and for the time, immoveably secured; and this position once attained, a repetition of concentricity is indispensable. A few years ago, an American engineer recommended the adoption of a cylindrical shoulder, a trifle larger than the thread of the screw, on the nose of the mandril—the chuck having a similar hollow to fit on this shoulder; but this is merely adding to our embarrassments: however, it serves to show that the screw, with all the difficulty attendant on its construction is by no means to be depended on. Experience tells me that a chuck is rarely or ever affixed to the mandril precisely in the same position it originally occupied; the error must not, in this instance, be attributed to any defect of workmanship, since I have found the same result with perfect and imperfect screws. Of course I use the expression "perfect" in a limited sense. What I mean is this—every possible care and attention had been bestowed on the external and internal screw; and that, by a competent and very experienced workman. But so long as we are compelled to cut the female screw in the chuck, by means of taps, or indeed any other method than the screw, on the mandril itself, we must be content to look for a continually varying position of our lathe chucks.

Yours obediently,

An Amateur Mechanic.

Mr. F. TALBOT'S METHOD OF PREPARING THE PAPER FOR THE CALOTYPE PROCESS.

To the Editor of the Penny Mechanic and Chemist.

Dissolve 100 grains of crystallized nitrate of silver in six ounces of distilled water. Wash the paper with this solution, with a soft brush, on one side, and put a mark on that side, to know it again. Dry the paper at a distant fire, or, let it dry spontaneously in a dark room. When dry, dip it into a solution of iodide of potassium, in the proportion of 500 grains to a pint of water, and let it stay two or three minutes in this solution. Then dip it into a vessel of water, dry it lightly with blotting-paper, and let it finish drying spontaneously. This is called *iodized paper*, because it has a uniform pale yellow coating of iodide of silver; it should be kept in a portfolio or draw, until required for use.

When you are about to make a drawing, take a sheet of iodized paper, and wash it with a solution of gallo-nitrate of silver, prepared in the following manner:—

Dissolve 100 grains of crystallized nitrate of silver in two ounces of distilled water, and add to this solution one-sixth of its volume of acetic acid.

Make a saturated solution of crystallized gallic acid, in cold distilled water. The quantity dissolved is very small; keep each of these liquids separate, and only mix them in small quantities, accordingly as they are required for use, as the mixture will not keep long without spoiling.

Wash the iodized paper with a mixture of these solutions, in equal volumes, with a soft brush, upon the side previously marked. Let the paper rest half-a-minute, and then dip it into water; dry it lightly with blotting-paper, and finally at a considerable distance from the fire: it is then fit for use.

All these operations had better be performed by candle-light

Impressions may be taken with this paper in the space of one second; but they at first appear latent and invisible, until they are brought out by warming the paper and washing it again (once or twice) with the *gallo-nitrate of silver*. They will then require to be fixed, by being washed with a solution of bromide of potassium containing 100 grains, dissolved in eight or ten ounces of water. After a minute or two, it should be again dipped in water, and then finally dried.

The calotype picture is a negative one in which the lights of nature are represented by shades; but being by this method very strongly fixed and perfectly transparent, there is no difficulty in copying them by the same process; when the copies will be positive, having the lights and shades conformable to nature.

The best writing-paper should be used.

I remain, yours &c.,

L. Hathway.

LIGHTNING CONDUCTORS FOR THE ROYAL NAVY.

A series of experiments have been performed by Snow Harris, Esq., F.R.S., on board the *Orestes*, on whose plan her lightning conductors are fitted up. A wire leading from the positive side of a powerful electrical battery, in the *Semaphore*, was attached to a cup of gunpowder on her main truck; another wire leading from the negative side of the battery, was attached to the gun in the boat. A short wire was placed on the touch-hole of the gun, and led over the gunwhale of the boat, tothes urface only of the water, on the side nearest the *Orestes*. There was no commmication between the ship and the barge. The electric fluid was made to pass down the mast by means of Mr. Harris's conductor, and thence out at her side, under the main chains, in a line with her lower-deck beams.

The object was, to show that immediately an electrical discharge reached the mast head, it passed down to, and was dispersed in, the water by means of the continuous line of conductors. This was proved thus:—The electric battery in the *Semaphore* was discharged, the discharge passed along the copper wire from the metallic plate on the interior of the jar to the mast-head. Its presence there was rendered apparent by the ignition of the powder in the cup; it passed thence down the conductor on the mast into the hull of the ship, and along the conductor in the hull into the sea. That it arrived in the sea, was proved by the ignition of the powder over the touch-hole of the gun in the boat, and the consequent discharge of the gun, because the only means by which this gunpowder could be ignited was the passage of the electricity up the short copper wire which connected the touch-hole of the gun with the sea. So that, not only must the electric fluid have arrived in the sea, but it must have passed through it to this short copper wire in the boat. It is almost needless to add, that so rapid is the passage of the electric fluid, that the report of the discharge of the battery, the

ignition of the powder at the mast-head, and that of the touch-hole of the gun, and the report of the gun itself, appeared simultaneous, notwithstanding the great distance traversed by the electricity—thus showing clearly and satisfactorily, that the instant the explosion arrived at the main truck, that the same instant did the conductors clear it off the ship, and transmit it to the water.

We doubt not the beauty, ingenuity, and talent of Mr. Snow Harris's experiment; and the fact that the electric fluid was dispersed in a tideway, and yet possessed sufficient influence to explode a gun at nearly 150 feet distance, was most beautifully exemplified: but yet, such is our ignorance and the ignorance of a large body of naval men of high ability and constant practice in Tropical latitudes, whose opinion we esteem, that we doubt the wisdom of inviting an enemy on board a ship, which might otherwise pass unheeded by. Mr. Snow Harris used a powerful electric apparatus, but what is that compared with the awful and appalling force of a flash of lightning? We should like to know, as far as the history of ships struck with lightning could be collected, the number with, and the number without, conductors of any description.

METHOD OF PREPARING MARBLED PAPER.

The principal difference in the various kinds of marbled paper, consists in the forms in which the colours are laid on the ground; some being disposed in circumvolutions, some in jagged lengths, and others in spots of an oval or roundish figure.

The general manner of managing each kind is, however, the same; being the dipping of the paper in a solution of gum-dragon, over which the colours previously prepared with ox-gall and spirits of wine, are first spread.

The solution of gum-dragon must be made by putting a sufficient portion of the gum, which should be quite white and clear, into clean water, and letting it remain there a day or two—frequently breaking the lumps, and stirring it till the whole appear dissolved and equally mixed with the water. The consistence of the solution should be nearly that of strong gum-water; it must be passed through a linen cloth, and being put into the trough, will be ready to receive the colours.

The colours employed for red, are—carmine, lake, rose pink, and vermilion; for yellow—Dutch pink and yellow ochre; for blue—Prussian blue and verditure; for green—verdigris and a mixture of Dutch pink with Prussian blue in various proportions; for orange—orange lake; for purple—rose pink mixed with Prussian blue. These several colours should be ground with spirits of wine till they be of sufficient fineness, and then at the time of using, a little fish-gall should be added, by grinding them over again with it. The proportion of gall must be just as much as will suffer the spots of colour when sprinkled on the solution, to form together without intermixing or running into each other. When everything is thus prepared, the solution of gum-dragon must be poured into a trough, and the colours being in separate pots with a pencil appropriated to each, must be sprinkled on the surface of the solution, by shaking the pencil, charged with its proper colour, over it; and this must be done with the several kinds of colour desired, till the surface be wholly covered. When the marbling is proposed to be in spots of a simple form, nothing more is necessary; but where the whirls or snail-shell figures are wanted, they must be made by means of a quill, which must be put among the spots, to turn them about till the effect be produced. The jagged lengths must be made by means of a comb five inches in length, made of wood, with brass teeth two inches long, placed about a quarter of an inch from each other. But if they be desired to be pointed both ways, the comb must be again passed through the trough in a contrary direction.

The paper should be previously prepared for receiving the colours, by dipping it overnight in water, and laying the sheets on each other with a weight over them. The whole being thus ready, the paper must be held by two corners, and laid, in the most gentle and even manner, on the solution covered with the colours, and softly pressed with the hand, that it may bear everywhere on the solution. After this it must be raised and taken off with the same care, and then hung to dry across a proper cord suspended near at hand for the purpose; and in that state it must continue till perfectly dry.

The paper must then be polished, in order to which it is first rubbed with a little soap, and then thoroughly smoothed by glass polishers, such as are used for linen, called *calendar glasses*. After this it must be again rubbed by a burnisher of glass ground to the highest pitch; for on the perfect polish of the paper depend its beauty and value.

Gold or silver powders may be used, if

desired, along with the colour; and require only the same treatment, except that they must be first tempered with gum-water.

HISTORY OF MEDALS.

(Continued from page 373.)

The Roman coins, which have been blundered in the manner formerly mentioned, are very rare, and undeservedly valued by connoisseurs. The blunders in the legends of these coins, which in all probability are the mere effects of accident, have been so far mistaken by some medallists, that they have given rise to imaginary emperors who never existed. A coin of Faustina, which has on the reverse SOUSTI. S. C. puzzled all the German antiquaries, till at last Klotz gave it the following facetious interpretation:—*Sine omni utilitate sectamini tantas ineptias.*

The heptarchic coins of England are generally rare, except those called *stycas*, which are very common, as well as those of Burgred King of Mercia. The coins of Alfred, which bear his bust, are scarce, and his other money much more so. Those of Hardyknute are so rare, that it was even denied that they had an existence; but Mr. Pinkerton informs us, that there are three in the British Museum, upon all of which the name HARTHICANUT is quite legible. No English coins of King John are to be met with, though there are some Irish ones; and only French coins of Richard I. "Leake (says Mr Pinkerton) made a strange blunder, in ascribing coins of different kings with two faces, and otherwise spoiled in the stamping, to this prince: in which, as usual, he has been followed by a misled number."

Coins of Alexander II. of Scotland, are rather scarce, but those of Alexander III. are more plentiful. Those of John Baliol are rare, and none of Edward Baliol are to be found.

Medals are to be had at the shops of goldsmiths and silversmiths, with those who deal in curiosities, &c. but in great cities there are professed dealers in them. The best method of purchasing medals, however, is that of buying old cabinets, which are every year exposed to auction in London. In these the rare medals are sold by themselves: but the common ones are put up in large lots, so that the dealers commonly purchase them. Mr. Pinkerton thinks it would be better that medals were sold by one; because a lot is often valued and purchased for the sake of a single coin; while the others separately, would sell for perhaps four times the price of the whole lot. "If any man of common sense and honesty (says Mr. Pinkerton), were to take up the trade of selling coins in London, he would make a fortune in a short time. This profitable business is now in the hands of one or two dealers, who ruin their own interest by making an elegant study a trade of knavery and imposition. If they buy 300 coins for 10*s.* they will ask 3*s.* for one of the worst of them! nay, sell forged coins as true to the ignorant. The simpletons complain of want of business. A knave is always a fool."

The gold coins of Carthage, Cyrene, and Syracuse, are worth about twice their intrinsic value as metal; but the other gold civic coins from 5*l.* to 30*l.* each. The only gold coins of Athens certainly known to exist, are two lately procured by the King. One of these remains in possession of his Majesty, but the other was given by the queen to Dr. Hunter. There was another in the British Museum, but suspected not to be genuine. Dr. Hunter's coin, then, if sold, would bear the highest price that could be expected for a coin.

The silver coins of Syracuse, Dyrrhachium, Massilia, Athens and a few other states, are common; the drachmas and coins of lesser size are worth about five shillings; the didrachms, tetradrachms, &c. from five to ten, according to their size and beauty; the largest, as might naturally be expected, being more valuable than the small ones. The tetradrachms, when of cities whose coins are common, are worth from 7*s.* 6*d.* to 1*l.* 1*s.*; but it is impossible to put a value upon the rare civic coins; ten guineas have been given for a single one.

The Greek copper coins are common, and are almost all of that kind called *small brass*; the middle size being scarce, and the largest in the ages prior to the Roman emperors extremely so. The common Greek coins of brass bring from 3*d.* to 18*d.* according to their preservation; but when of cities, whose coins are rare, much higher prices are given. "The want of a few cities, however (says Mr. Pinkerton), is not thought to injure a collection; as indeed new names are discovered every dozen of years, so that no assortment can be perfect. To this it is owing that the rarity of the Grecian civic coins is not much attended to."

The gold coins of Philip and Alexander the Great being very common, bear but from five to ten shillings above their intrinsic value; but those of the other princes, being rare, sell from 3*l.* to 30*l.* each, or even more.

The tetradrachms are the dearest of the silver monarchic money, selling from five to ten shillings; and if very rare, from 3*l.* to 30*l.* Half these prices may be obtained for the drachmas, and the other denominations in proportion.

The Greek copper coins are for the most part scarcer than the silver, except the Syro-Grecian, which are common, and almost all of the size called small brass. They ought (says Mr. Pinkerton), to bear a high price; but the metal and similarity to the copper civic coins, which are common, keep their actual purchase moderate, if the seller is not well instructed, and the buyer able and willing to pay the price of rarity."

The name of weights given to the ancient Roman ases is, according to our author, exceedingly improper; as that people had weights of lead and brass sides, without the least appearance of a portrait upon them. These denote the weight by a certain number of knobs; and have likewise small *fleurettes* engraved upon them. According to Mr. Pinkerton, whenever we meet with a piece of metal stamped on both sides with busts and figures, we may lay it down as a certain rule that it is a coin; but when slightly ornamented and marked upon one side only, we may, with equal certainty, conclude it to be a weight.

The ancient Roman ases are worth from 2*s.* to 2*l.* according to the singularity of their devices. Consular gold coins are worth from 1*l.* to 5*l.* Pompey with his sons 21*l.* and the two Bruti 25*l.* The silver coins are universally worth from a shilling to half-a-crown, excepting that of the cap of liberty and a few others, which, if genuine, will bring from 10*s.* to 5*l.* The consular copper bears an equal price with the silver, but is more rare; the consular silver coins restored by Trajan are worth 20*s.* each.

With regard to the Roman imperial coins, it is to be observed, that some of those which belong to princes whose coins are numerous, may yet be rendered extremely valuable by uncommon reverses. Mr. Pinkerton particularly points out that of Augustus, with the legend C. MARIVS TROGVS, which is worth three guineas, though the silver coins of that prince in general are not worth above a shilling. In like manner, the common gold coins of Trajan are not worth above twenty shillings; while those with *Basilica Ulpia, Forum Trajani, Divi Nerva et Trajanus, Pater, Divi Nerva et Platina Aug. Profectio Aug. Regna Assignata, Rex Parthus,* and some others, bear from three to six pounds. The ticket medals belong to the Roman senate, and are worth from three to ten shillings. The forged coins and medallions of the Paduan sell from one to three shillings each.

(To be continued.)

MISCELLANEA.

"*The Light of all Nations.*"—We perceive by paragraphs in the columns of our contemporaries, that an attempt is still made to keep alive in the public mind a hope of success from the experiment for fixing a lighthouse on the Goodwin Sands. We have been reproached, and even threatened with legal proceedings, for stating the facts on which we have ventured to predict the utter hopelessness of the project, which has virtually exploded; and, having thus performed our duty to the public, we shall abstain from farther allusion to it.—*Globe.*

Electricity.—That machine electricity is so popular in its displays, arises from the breadth of its aerial stratum. That voltaic electricity displays so little, arises from its compact mode of generation. And that magnetic electricity acts only on iron, is because it is a power of the mere structure. The poles of the three are alike; thus, a prime conductor is negative near the exciting cylinder, and positive at its extremity, where it is rendered all around in negative; a voltaic arrangement has also its polar ends; and so likewise a magnet; and in both cases, the same elements are operating, fixing, and exploding. The only difference is, that the voltaic elements were abstracted from elements previously in the natural force of union, and each by that force seeking re-union; and, in the latter, they were separately evolved from manganese and zinc, without previous relation, and brought together by mechanical agency.—*Phillips.*

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, November 2, Mrs. C. L. Balfour, on Prejudice. Friday, November 4, T. Williams, Esq., on the Organs of Support and Locomotion in Man and the lower Animals. At half-past eight precisely.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, Oct. 31, C. Taylor, Esq., on Phrenotypics or the Art of Memory. At a quarter-past eight o'clock.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, November 3, C. Johnson, Esq. &c., on Physical Geography. At half-past eight o'clock.

QUERIES.

Can any of your correspondents inform me where I can procure that imitation of liquid gold used by paper-printers? and what is the proper name of it, and about the price?

O. O.

Where can the lenses for a magic lantern, about three inches in diameter, be obtained? The method of painting the slides; also, the substance upon which the scenes for the dissolving views are painted? J. D. I.

The manner in which the dissolving views are made and shown, so as to change almost unobserved, similar to those shown at the Royal Polytechnic Institution? How I can make them and the lantern itself in the cheapest manner? and what focus glasses I should get, and where I could procure them, and about what the cost will be of the whole apparatus, burning oil instead of gas. Which information will, I doubt not, prove acceptable to many of your subscribers besides myself. J. D.

ANSWERS TO QUERIES.

If "J. Reid" will favour me with a visit, I will give him every information that lies in my power respecting the subject he solicits, practically. T. R. BILBROUGH.

18, Golden Lane, Cripplegate.

SIR,—For the information of your correspondent "J. C.," I subjoin the following recipes to make blue writing-ink:—Take of Prussian blue, one drachm; oxalic acid, two drachms; powdered gum, half-a-drachm; water, four ounces. Rub the Prussian blue and oxalic acid together in a mortar to a fine powder, then add the water gradually, and lastly add the gum. This ink will resist acids, but will be destroyed by alkalies. I am aware that a recipe appeared in No. 102, with the same ingredients, except that there is no gum, which will be found highly necessary; as without it this ink will sink deeply into the paper, and consequently fade in colour.

Another Blue Ink that turns black.—Dissolve indigo in sulphuric acid, by powdering the indigo and boiling it in the acid; then add gradually boiling water until the colour is sufficiently diluted; it will then be a solution of sulphate of indigo; add chalk to neutralize the acid, and you will then have a solution of indigo in water, while the insoluble sulphate of lime will fall to the bottom of the vessel; add to a pint of this solution—one oz. of powdered galls—one oz. of logwood—half-an-oz. of sulphate of iron. J. W. West.

"H. C." "Consolations in Travel; or, the Last Days of a Philosopher," by Sir Humphrey Davy, was published by Mr. Murray, Albemarle Street.

"G. L." should have stated that malleable cast iron is very liable to rust; having been deprived of the superabundant carbon, it has, I suspect, a strong affinity for oxygen. I doubt whether "G. L." has given the details of the process correctly, the rationale of which is, to extract the carbon by the presence of any substance, such as poor iron ore, into which the carbon enters. I should be glad to see this subject elucidated by a practical man. The original patentee was Mr. Samuel Lucas, of Sheffield.

"J. W." (No. 105.) French chalk is usually employed to assist those who, from choice or necessity, wear tight boots. Every person who has any regard to comfort, should, on no account, wear tight boots. 2. The process of gilding is well and minutely described in the "Dictionnaire Technologique;" the article in question is translated and published in "Gill's Technical Repository." 3. Bronze is a compound of metals; the best account I have ever met with on this article, is a paper translated from the French, in "the Technical Repository." "The Manuel des Alliages Metalliques," par. M. Herve, published at three fr. 50 centimes, may be consulted with advantage. See also "Francis' Dictionary of the Arts and Sciences." 4. Window glass is easily ground by means of sand, or emery and water.

"N. M. T." (No. 106.) 1. All files are cut by hand, the process is extremely simple, but the result depends entirely on the dexterity of the workman. A very complete account is given in "Luke Herbert's Engineers' and Mechanics' Encyclopædia." Many attempts have been made to fabricate files by machinery, but invariably, I understand, without success. A design and description of such a machine will be found in "Nicholson's Operative Mechanic," p. 314. pl. 42. No. 315. 5. The simplest mode of drawing an ellipse (oval) is by means of the common trammel. Many ingenious, but, unfortunately, too expensive modes have been suggested by Cubitt, Farey, Jun., and others; all of which possess considerable merit, and effect the object proposed; but, as already observed, the construction is too costly for general use. A simple and unexpensive compass for tracing the elliptic curve, would be invaluable to a large class of artizans. The only certain method of dividing any circular surface into any number of equal parts, whether odd or even, is by means of an accurately divided plate and a proper machine. The subject is very ably discussed in "Rees' Cyclopædia," under "circle" and "Graduation," where the different plans of Bird, Troughton, the Duc de Chalins, and other eminent mechanicians, are expounded.

"PHILOMELA." 1. Chloride of lime. 6. I believe putty, when hardened by time, cannot be rendered sufficiently soft to allow the glass to be removed from the frame; at least I never found any solvent answer the purpose, although I have tried many.

AN AMATEUR MECHANIC.

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

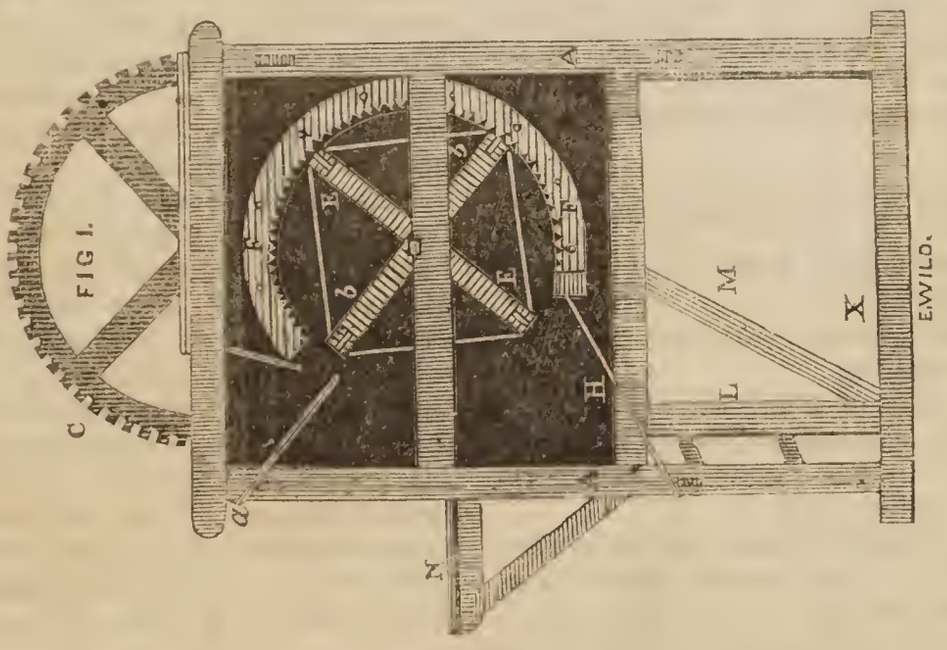
THE PENNY MECHANIC

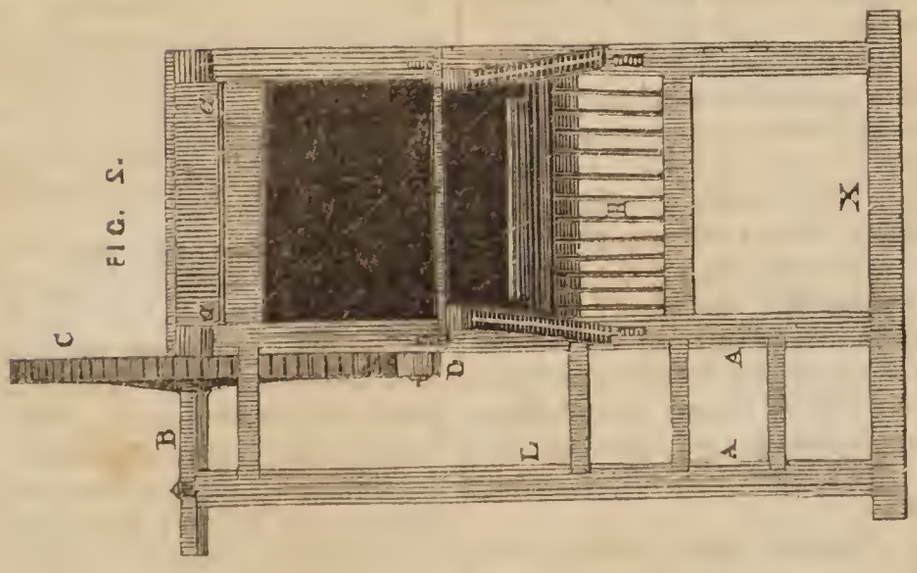
AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 108, THIRD SERIES. | SATURDAY, NOV. 5, 1842. | No. 356, OLD SERIES.

LEE'S THRASHING-MACHINE.





Vol. VIII.—No. 49.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

LEES' THRASHING-MACHINE.

(See Engravings, front page.)

The inventor of this machine being largely concerned in agriculture, and having 800 acres of arable land, found that a thrashing-machine became absolutely necessary for the continuance of his occupations. He, therefore, erected one that had been recommended to him; but, from the complication of its structure, its being frequently out of order, and from its bad performance of the work at all times, he resolved to try to have a thrashing-machine made under his own directions, more simple in its construction, and more efficacious in its operations. With this view, he continued his experiments for nearly three years, and, after an expenditure of about 300*l.* he succeeded in the construction of the machine, which answered his purpose in the most satisfactory manner.

Description of the Engravings.

Figs. 1 and 2 give a side and end view of the machine.

A, in both figures, represents the framing of the machine.

B is the shaft of a cog-wheel, C, which is turned by cog-wheels, from the great horse-wheel, in the same manner as the ordinary thrashing-mill.

C. the cog-wheel, turns a small pinion, D, to which it gives a rapid revolution; on the axis of the pinion, the beaters, E E, are fixed, and revolve with it, within a segment or drum, formed of iron plates, grooved or ribbed, parallel to the axis, as the figure represents, and connected together by wooden curbs, F F, to which they are screwed.

a a is the feeding-board, upon which the corn is placed to enter the machine. The end of this board is fixed very near to the four vanes, or beaters, *b b b b*; as these revolve rapidly, they strike the heads of the corn upwards, with such a jerk as to beat out all the corn from those ears which they meet fairly; but if any escape, they are drawn in, together with the straw, and rubbed round by the beaters, against the inside of the ribbed drum or cylinder, F, so as to open the ears and let out the corn, though the ears come in any position whatever.

At H is a grating, upon which the beaters deliver the corn, chaff, and straw together; the two former fall through upon the ground at X, and the latter slides down upon the grate. The corn is afterwards to be dressed in a winnowing-machine, which separates the light and heavy corn from the chaff.

The curbs, F F, are fixed by screws, which can be adjusted, so as to bring the cylinder nearer to, or farther from, the beaters, to adapt the machine for thrashing different kinds of grain; for it is evident that peas, beans, &c., must require more space to rub them in than the smaller grain, as wheat and barley.

L, fig. 1, is one of the uprights of the frame, which supports the bearing for the axis, B, of the cog-wheel; and M is an oblique brace, which strengthens the frame.

N is the stage on which the man who feeds the machine stands.

This machine requires no rollers for entering the corn to be thrashed. It is about two feet six inches in length; two horses are sufficient to work it; and from half-past seven to two o'clock, they will, without fatigue, thrash two loads of oats, each of forty bushels.

The vanes within the cylinder revolve from 100 to 120 times for one round of the horses, in a space of twenty-two feet in diameter. The four vanes within the drum or cylinder, are each one inch and a half thick, and enclosed to within about three inches of their exterior edges. The drum or cylinder within which the vanes turn, is close-fluted with wood of about an inch thick, and is in moveable parts, so as to admit of being placed, as above noticed, nearer to, or farther from, the vanes, as the corn to be thrashed may require.

PLATING.

To the Editor of the Penny Mechanic and Chemist.

Sir,—If the following description of the art and process of plating be considered worthy of insertion in your valuable Magazine, it is at your service, and, I doubt not, it will prove acceptable to your readers.

I am yours, &c.,

B. H. Sidney.

The art of plating is said to have been first invented by a spoon-maker, a workman of Birmingham, who, in order to remedy the inconvenience caused by the flexibility of solid silver, making spoons liable to be bent by the slightest accident, contrived to make the branches of a pair of spoons hollow, and to fill the hollow with a slender rod of steel or iron. Finding this a great improvement, and being desirous to add cheapness to utility, he continued to make the hollow larger, and,

of course, the iron thicker and thicker; till, at last, he discovered the means of coating an iron spoon with silver in such a manner as to make it equally elegant with those which were made entirely of that metal. The invention was quickly applied to other purposes, and to numberless utensils which were formerly made of brass or iron, are now given the strength of those metals, and the elegance of silver, for a small additional expense.

The silver plate is generally made to adhere to the baser metal by means of solder, which is of two kinds, the soft and the hard, or the tin and silver solders. The former of these consists of tin alone; the latter, generally, of three parts silver and one brass. When a buckle, for instance, is to be plated by means of the soft solder, the ring before it is bent is tinned, and then the silver plate is gently hammered upon it; the hammer being always covered with a piece of cloth. The silver now forms, as it were, a mould to the ring, and whatever of it is not intended to be used, is cut off. This mould is fastened to the ring of the buckle by two or three cramps of simple iron wire; after which the buckle, with the plated side undermost, is laid on a plate of iron sufficiently hot to melt the tin, but not the silver. The buckle is then covered with powdered resin, or anointed with turpentine; and, lest there should be a deficiency of tin, a small portion of rolled tin is likewise melted on it. The buckle is now taken off with tongs, and laid on a bed of sand, where the plate and the ring, while the solder is yet in a state of fusion, are more closely compressed by a smart shock with a block of wood. The buckle is afterwards bent and finished. Sometimes the melted tin is poured into the silver mould, which has been previously rubbed over with some flux. The buckle ring is then put among the melted tin, and the plating finished. This is called *filling up.*

When the hard solder is employed, the process is, in many respects, different. Before the plate is fitted to the iron or other metal, it is rubbed over with a solution of borax. Strips of silver are placed along the joinings of the plate, and, instead of two or three cramps, as in the former case, the whole is wrapped round with small wire; the solder and joinings are again rubbed with the borax, and the whole put into a charcoal fire till the solder be in fusion. When taken out, the wire is instantly removed; the plate is cleaned by the application of some acid, and afterwards made smooth by the stroke of a hammer.

Metal plating is, when a bar of silver and one of copper are taken of at least one equal side. The equal sides are made smooth, and the two bars fastened together by wire wrapped round them. These bars are then sweated in a charcoal fire, and, after sweating, they adhere as closely together as if they were soldered. After this they are flattened into a plate between two rollers, when the copper appears on one side, and the silver on the other. This sort of plate is called plated metal.

PLASTER OF PARIS.

Plaster of Paris is a preparation of several species of gypsum found near Paris, whence its name. The best sort is hard, white, shining, and marbly. It will neither give fire with steel, nor ferment with aquafortis, but very freely calcines in the fire into a fine plaster; the use of which, in building and casting statues, is well known. If plaster of Paris be put into a basin over a fire, it will, when hot, assume the appearance of a fluid, by rolling in waves, yielding to the touch, steaming, &c.; all of which properties it again loses in the departure of the heat, and, being thrown upon paper, will not at all wet it, but immediately discover itself to be as motionless as before it was set over the fire: whereby it appears, that a heap of such little bodies as are neither spherical nor otherwise regularly shaped, nor small enough to be below the discernment of the eye, may, without fusion, be made fluid, barely by a sufficiently strong and various agitation of the particles which compose it, and, moreover, lose its fluidity immediately upon the cessation thereof.

Two or three spoonfuls of burnt plaster of Paris, mixed up thin with water, in a short time, coagulates, at the bottom of a vessel full of water, into a hard lump, notwithstanding the water that surrounded it. Artificers observe, that the coagulating property of burnt plaster of Paris will be very much impaired or even lost, if kept too long, especially in the open air, before it is made use of; and when it has been once tempered with water, and suffered to grow hard, they cannot, by any burning or powdering it again, make it serviceable for their purpose as before.

The method of representing a face truly in plaster of Paris, is this:—The person whose figure is designed, is laid on his back, with any convenient thing to keep off the hair. Into each nostril is conveyed a conical piece of paper, open at both ends, to allow of respiration. These tubes being

anointed with oil, are supported by the hand of an assistant; then the face is lightly oiled over, and the eyes, being kept shut, plaster of Paris, fresh calcined and tempered to a thinnish consistence with water, is by spoonfuls nimbly thrown all over the face, till it lies near the thickness of an inch. This matter grows sensibly hot, and, in about a quarter of an hour, hardens into a kind of stony secretion, which, being gently taken off, represents, on its concave surface, the minutest part of the original face. In this, a head of good clay may be moulded, and therein the eyes are to be opened, and other necessary amendments made. This second face being anointed with oil, a second mould is made, consisting of two parts joined lengthwise along the ridge of the nose; and herein may be cast, with the same matter, a face extremely like the original.

HISTORY OF MEDALS.

(Continued from page 383.)

Of the coins of other nations, those of Hilderic, King of the Vandals, are in silver, and worth 10*s.*; the small brass of Athanaric, 5*s.*; the gold of Theodoric, 2*l.*; the second brass of Theodahat, 5*s.*; the second brass of Badueta, rare, and worth 10*s.*; the third brass, 3*s.* The British coins are very rare, and worth from 10*s.* to 2*l.* 2*s.* each; sometimes much more. Medals with unknown characters are always scarce and dear. Saxon pennies, of the heptarchy, are rare, and worth from 10*s.* to 10*l.*, according to their scarcity and preservation. The coins of the English kings are common; those of Edward the Confessor in particular; others are rare, and worth from 10*s.* to 2*l.* 2*s.*, while two of Hardyknute are worth no less than ten guineas. The gold medals of Henry, in 1545, and the coronation of Edward, are worth 20*l.* each; the Mary of Trezzo, 3*l.*; Simon's head, of Thurloe, in gold, is worth 12*l.*; his oval medal in gold, upon Blake's naval victory, is worth 30*l.*; and his trial piece, if brought to a sale, would, in Mr. Pinkerton's opinion, bring a still higher price. The medals of Queen Anne, which are intrinsically worth about two guineas and a half, sell for about 3*l.* each; the silver, of the size of a crown piece, sell for 10*s.*, and the copper from 5*s.* to 10*s.* Dassier's copper pieces sell from 2*s.* to 5*s*, and a few bear a higher price.

The Scottish gold coins sell higher than the English, but the others are on a par. The shilling of Mary, with the bust, is rare, and sells for no less than 30*l.*; the half, 3*l.*; and the royal, 5*l.* 5*s.* The French testoon of Francis and Mary brings 10*l.* 10*s.*, and the Scottish one of Mary and Henry would bring 50*l.*, as would also the medal of James IV. The coronation medal of Francis and Mary is worth 20*l.* Briot's coronation medal, sold in 1755, only for two guineas at Dr. Mead's sale; but would now bring 20*l.*, if sold according to rarity.

The English coins struck in Ireland, are of much the same price with those of the native country; but the St. Patrick halfpence and farthings are rather scarce, and the rare crown of white metal is worth 4*l.* The gun-money of James II., and all other Irish coins, are very common.

Having thus given a full account of everything in general relative to medals, we must now come to some particulars respecting their arrangement, and the entertainment which a medallist may expect from the trouble and expense he is at in making a collection.

It has already been observed, that one of the principal uses of medals, is the elucidation of ancient history. Hence the arrangement of his medals is the first thing that must occur in the formation of a cabinet. The most ancient medals with which we are acquainted, are those of Alexander I., of Macedon, who began to reign about 501 years before Christ. The series ought, of consequence, to begin with him, and to be succeeded by the medals of Sicily, Caria, Cyprus, Heraclia, and Pontus. Then follow Egypt, Syria, the Cimmerian Bosphorus, Thrace, Bithynia, Parthia, Armenia, Damascus, Cappadocia, Paphlagonia, Pergamus, Galatia, Cilicia, Sparta, Pæonia, Epirus, Illyricum, Gaul, and the Alps, including the space of time from Alexander the Great to the birth of Christ, and which is to be accounted the third medallic series of ancient monarchs. The last series goes down to the fourth century, including some of the monarchs of Thrace, Bosphorus, and Parthia, with those of Comagene, Edessa, or Osrhoene, Mauritania, and Judæa. A most distinct series is formed by the Roman emperors, from Julius Cæsar to the destruction of Rome by the Goths; nay, for a much longer period, were it not that towards the latter part of it, the coins become so barbarous as to destroy the beauty of the collection. Many series may be formed of modern potentates.

By means of medals, we can, with great certainty, determine the various ornaments worn by ancient princes as badges of distinction. The Grecian kings have gene-

rally the diadem, without any other ornament; and though, in general, the side of the face is presented to view, yet, in some very ancient Greek and Roman consular coins, full faces of excellent workmanship are met with. On several coins, also, two or three faces are to be seen, and these are always accounted very valuable.

The diadem, which was no more than a ribbon tied round the head, with a floating knot behind, adorns all the Grecian princes from first to last, and is almost an infallible mark of sovereign power. In the Roman consular coins, it is seen in conjunction with Numa and Ancus, but never afterwards till the time of Licinius, the colleague of Constantine. Dioclesian, indeed, according to Mr. Gibbon, first wore the diadem, but his portrait upon coins is never adorned with it. So great an aversion had the Romans to kingly power, that they rather allowed their emperors to assume the radiated crown, the symbol of divinity, than to wear a diadem; but, after the time of Constantine, it becomes common. The radiated crown appears first on the posthumous coins of Augustus, as a mark of deification, but in somewhat more than a century became common.

The laurel crown, at first a badge of conquest, was afterwards permitted by the senate to be worn by Julius Cæsar, in order to hide the baldness of his head. From him, all the emperors appear with it on their medals, even to our own times. In the lower empire, the crown is sometimes held by a hand above the head, as a mark of piety. Besides these, the naval, mural, and civic crowns, appear on the medals both of emperors and other eminent men, to denote their great actions. The laurel crown is also sometimes worn by the Greek princes. The Arsacidæ of Parthia wear a kind of sash round the head, with their hair in rows of curls like a wig. The Armenian kings have the tiara, a kind of cap, which was esteemed the badge of imperial power in the East. Conical caps are seen on the medals of Xerxes, a petty prince of Armenia, and Juba, the father, the former having a diadem around it.

The impious vanity of Alexander and his successors in assuming divine honours, is manifest on their medals, where various symbols of divinity are met with. Some of them have the horn behind their ear, either to denote their strength, or that they were the successors of Alexander, to whom this badge might be applied, as the son of Jupiter Ammon. This, however, Mr. Pinkerton observes, is the only one of these symbols which certainly denotes an earthly sovereign, it being doubted whether the rest are not all figures of gods. According to Eckhet, even the horn and diadem belong to Bacchus, who invented the latter to cure his headaches; and, according to the same author, the only monarch who appears on coins with the horn, is Lysimachus. We are informed, however, by Plutarch, that Pyrrhus had a crest of goat's horns to his helmet; and the goat, we know, was a symbol of Macedon. Perhaps the successors of Alexander wore this badge of the horn in consequence. The helmet, likewise, frequently appears on the heads of sovereigns, and Constantine I. has helmets of various forms, curiously ornamented.

THE CHEMIST.

SODIUM.

Sodium is white, opaque, and, when examined under a film of naphtha, has the lustre and general appearance of silver. It is exceedingly malleable, and is much softer than any of the common metallic substances. When pressed upon by a platina blade, with a small force, it spreads into thin leaves, and a globule of the one-tenth or one-twelfth of an inch in diameter is easily spread over a surface of a quarter of an inch, and this property does not diminish when it is cooled to 32° Fahrenheit.

It conducts electricity and heat in a similar manner to the basis of potassa; and small particles of it inflame by the galvanic spark, and burn with bright explosions.

Its specific gravity is less than that of water. It swims in oil of sassafras of 1.096, water being one, and sinks in naphtha of specific gravity 861. By mixing together oil of sassafras and naphtha, until a fluid was formed, in which the globule of sodium remained at rest above or below, Sir H. Davy found its specific gravity to be to that of water, nearly as nine to ten, or, more accurately, as 9348 to 1.

Sodium has a much higher point of fusion than potassium, its parts begin to lose their cohesion at about 120° Fahrenheit, and it is perfectly fluid at about 180°, so that it readily fuses under boiling naphtha; it is also less volatile, and remains fixed in a state of ignition at the point of fusion of plate glass.

When sodium is exposed to the atmosphere, it immediately tarnishes, and, by degrees, becomes covered with a white crust, which deliquesces much more slowly

than the substance that forms on the basis of potassa. This crust is pure soda.

The basis of soda combines with oxygen slowly, without any luminous appearance, at common temperatures, and, when heated, this combination becomes much more rapid; but no light is emitted until it has acquired a temperature nearly that of ignition. The flame that it produces in oxygen gas is white, and it sends forth bright sparks, occasioning a very beautiful effect. In common air, it burns with light of the colour of that produced during the combustion of charcoal, but much brighter.

When thrown upon water, it produces a violent effervescence with a loud hissing noise: it combines with the oxygen of the water to form soda, which is dissolved, and its hydrogen is disengaged. In this operation there is no luminous appearance; but, when it is thrown into hot water, the decomposition is more violent, and, in this case, a few scintillations are observed at the surface of the fluid, owing to small particles of the base, which are thrown out of the water sufficiently heated to burn in passing through the atmosphere. And when a globule is brought in contact with a small particle of water, or with moistened paper, the heat produced (there being no medium to carry it off rapidly), is usually sufficient for the ascension of the sodium.

The base of soda, when thrown upon the strong acids, acts upon them with great energy. When nitrous acid is employed, a vivid inflammation is produced: with muriatic and sulphuric acid there is much heat generated, but no light. When plunged beneath the surface of the acids, it is rapidly oxygenated; soda is produced, and combines with the acid.

Sodium, in its degrees of oxidation, has precisely similar habits with the base of potassa. When it is fused with dry soda in certain quantities, there is a division of oxygen between the alkali and the base, and a deep-brown fluid is produced, which becomes a dark-grey solid on cooling, and which attracts oxygen from the air, or which decomposes water, and becomes soda.

The same body is often formed in the analytic processes of decomposition, and it is generated when the basis of soda is fused in tubes of the purest plate glass.

Sodium, when heated with hydrogen gas, does not, like potassium, appear to be dissolved; and, as no luminous appearance attends the oxidation of it in cold water, it does not appear to be capable of combining even with nascent hydrogen.

There is scarcely any difference in the visible phenomena of the agencies of the basis of soda, and that of potassa on sulphur, phosphorus, and the metals.

It combines with sulphur in close vessels, filled with the vapour of naphtha, with great vividness, with light, heat, and often with explosion, from the vaporization of a portion of sulphur, and the disengagement of sulphuretted hydrogen gas. The sulphuretted base of sulphur is of a deep-grey colour. The phosphuret has the appearance of lead, and forms phosphate of soda by exposure to the air, or by combustion.

Sodium combines with the metals; in the quantity of one-fortieth, it renders mercury a fixed solid of the colour of silver, and the combination is attended with a considerable degree of heat. It makes an alloy with tin, without changing its colour, and it acts upon gold and lead when heated. In its state of alloy, it is soon converted into soda by exposure to air, or by the action of water, which it decomposes with the evolution of hydrogen. The amalgam of mercury and sodium seems to form triple compounds with other metals. It likewise combines with sulphur, and forms a triple compound of a dark-grey colour.

MANGANESE.

This metallic substance seems, after iron, to be the most frequently diffused metal through the earth; its ores are very common. As a peculiar metal, it was first noticed by Gahn and Scheele, in the years 1774 and 1777. It is always found in the state of an oxide, varying in the degree of oxidation. La Peyrouse affirmed, that he had found manganese in a metallic state; but there was, probably, some mistake in his observation. They are distinguished into grey oxide of manganese, black oxide of manganese, reddish-white oxide of manganese, and carbonate of manganese. All these combinations have an earthy texture; they are very ponderous; they occur both amorphous and crystallized, and generally contain a large quantity of iron. Their colour is black, blackish-brown, or grey; seldom white. They soil the fingers like soot. They are sometimes crystallized in prisms, tetrahedral, rhomboidal, or striated.

Manganese is of a whitish-grey colour. Its fracture is granulated, irregular, and uneven. It is of a metallic brilliancy, which it, however, soon loses in the air. Its specific gravity is about 6.850. It is very hard, and extremely brittle. It is

one of the most refractory metals, and most difficult to fuse, requiring at least 160° of Wedgwood's pyrometer. Its oxidability is so rapid, that exposure to the air is sufficient to render it red, brown, black, and friable, in a very short time; it can, therefore, only be kept under water, oil, or ardent spirit. It is the most combustible of all the metals. It decomposes water by heat very rapidly, as well as the greater part of the metallic oxides. It decomposes sulphuric acid. It is soluble in nitric acid. It is fusible with earths, and colours them brown, violet, or red, according to its state of oxidation. It discolours glasses tinged by iron. It does not appear to unite with sulphur. It combines with phosphorus. It unites with gold, silver, and copper, and renders them brittle. It unites to arsenic in close vessels, but does not enter into union with mercury. It forms three differently coloured oxides, by combining with different portions of oxygen.

This metal is obtained by mixing the black oxide, finely powdered, with pitch; making it into a ball, and putting this into a crucible, with powdered charcoal, one-tenth of an inch thick at the sides, and one-fourth of an inch deep at the bottom. The empty space is then to be filled with powdered charcoal, a cover is to be luted on, and the crucible exposed, for an hour, to the strongest heat that can be raised. Or, digest the black oxide of manganese repeatedly, with the addition of one-sixteenth of sugar, in nitric acid; dilute the mixture with three times its bulk of water; filter it, and decompose it by the addition of potash; collect the precipitate, form it into a paste with oil, and put it into a crucible, well lined with charcoal. Expose the crucible, for at least two hours, to the strongest heat of a forge.

Manganese may also be obtained in the following manner:—

Prepare a saturated solution of sulphate of manganese, bring it to a boiling heat, and add to it, gradually, a solution of tartrate of potash, until no farther precipitate ensues; then filter the solution, and wash the precipitate in water, and, when dry, make it into a paste with oil, and proceed as before.

In this process, the sulphuric acid unites to the potash, and forms sulphate of potash, and the tartareous acid joins to the manganese, and forms a tartrate of manganese, which is decomposable by heat.

MISCELLANEA.

Cheap Food for Horses.—A proposition has been made to the French Minister of War by a M. Longchamp, to try a new method of feeding horses, which he asserts will produce a vast saving in the amount of forage necessary for the army. This gentleman proposes to make a sort of bread, three-fourths potatoes and the rest oatmeal, with which the horses are to be fed in place of oats. The average quantity of oats for a horse per day, M. Longchamp estimates to be 10 lbs., costing about thirteen sous. He proposes to replace this food by 10 lbs. of the bread made with oats and potatoes, the price of which will be only five sous, leaving a saving of eight sous a-day. As there are 80,000 horses in the army, a saving would arise on the whole of the cavalry, of 11,680,000 francs a-year. M. Longchamp considers this food to be more nutritious than the food generally given to horses; for a great portion of the oats taken by a horse is imperfectly masticated, and, therefore, the nutritive qualities are allowed to remain latent. Heat and moisture, he declares, are necessary to bring forth fully the qualities of the fecula of oats, and this can be procured most effectually, by subjecting it to the heat of an oven, after having been moistened and well mixed up.

Lightning Conductors for Ships.—On this subject we are assured that it is the intention of Lieut. James Sabben, R.N., to deliver a public lecture, in which he will point out the *unscientific* adaptation of those of Snow Harris, Esq., F.R.S., and the complete destruction that may be apprehended to ensue both to masts and the hulls of ships, fitted according to that exceedingly inconsistent arrangement.—Lieutenant Sabben states to us, that the highly imposing and fascinating experiment lately shown by that gentleman, has no more direct relation towards establishing the perfection and superiority of his conductors over those of wire rope, than the experiment of a similar nature made by General Pasley when destroying the wreck of the *Royal George;* the success in both instances depending on the same cause—viz. the complete formation of the electric circle, and the full and entire command which the experimenter has on these points in the circle where he intends explosions shall take place; a command, be it carefully noticed, that no human power possesses in directing the discharge of atmospheric electricity. Between the natural effects of lightning and those resulting from the experiment made, Lieut. S.

persists there is as much comparative difference, as between Van Amburg putting his head into the mouth of a duly-trained and tame lion, and that of trying the same foolish and censurable exploit with a wild and unbroken animal.

Boilers of War Steamers.—An experiment was tried on board the *Excellent* gunnery ship, a few days ago, to test the efficacy of the defences of the boilers in steam-ships of war. One of the greatest difficulties to surmount, in order to render the steam navy of greater efficiency in action, is, to afford adequate protection to the boilers against the shot of the enemy, as a ball perforating them would at once place the vessel *hors de combat.* With the view of affording this protection to their boilers, several war steamers have been fitted up with extra defences, at the parts where the boilers are fixed. These defences consist of fifteen plates or layers of metal, each three-eighths of an inch thick. The object of the experiment on board the *Excellent*, was, to ascertain what resistance these defences of boilers would offer to a cannonade at point blank distance, which is 400 yards. An iron target was prepared, made exactly of the material which constitutes the protection of a boiler of a steamer, and placed at a distance of 400 yards from the ship, from which guns of a different calibre were fired at it. The first shot that was fired was an eight-inch hollow shot, and was projected from a sixty-eight pounder medium gun. It struck the bull's-eye, or centre of the target, and, indenting it to the depth of about five inches, rebounded therefrom, and was split into several pieces by the concussion. The second shot was a solid thirty-two pounder, and was fired from a gun of nine feet six inches; it struck the edge of the target, glanced off, and was split into two pieces. The third shot hit the centre of the target, where it lodged, having penetrated several plates. The fourth shot struck the third, and sent it clean through all parts of the iron, splitting it into numberless pieces, which were found on the off side of the wooden stage on which the target was fixed. The fifth and sixth shots went through the perforation made by the third and fourth. About ten other shots were fired, all striking the target in various parts, and completely destroying it. The result of this experiment has shown how totally inadequate are the present defences of the boilers of war steamers to protect them from the assaults of the enemy, where a precision of fire has been attained.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, November 9, Mrs. C. L. Balfour, on Prejudice. Friday, November 11, T. Williams, Esq., on the Organs of Support and Locomotion in Man and the lower Animals. At half-past eight precisely.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, November 7, Thomas Tagg, Jun., Esq., on Phrenotypics, or the Art of Memory. At a quarter-past eight o'clock.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, November 10, Thomas James Serle, Esq., on the Plays and Characters of Shakspeare. At half-past eight o'clock.

QUERIES.

Inventicus.—*The last notice was to a correspondent who writes on the same subject, and signs the same name: hence the mistake. Our correspondent might well be surprised.*

The address of Charles Whitlaw, Esq., is 69, Oxford Terrace, Hyde Park. We shall be glad to see our correspondent, with a description of his invention.

J. W. M. *is informed, that the subject on which he writes is quite foreign to the design of our Journal. It would better suit the columns of a weekly newspaper.*

A Student *wishes to know what the metallic substance called pinchbeck is composed of. The name is, we believe, almost obsolete: but it is generally composed of about equal parts of copper and zinc.*

S. T.—*We have been informed, that European plumbers cannot, or, at least, that they do not, imitate the thinness to which lead is reduced by the Chinese for their tea-boxes. The following account of the process is copied from a work on the subject, and which was communicated by an officer of an East Indiaman. "The caster sets by a pot which contains the melted metal, and has two large flat stones, the under one fixed, the upper moveable, directly before him. He raises the upper stone, by placing his foot on the side of it, and, with an iron ladle, pours in the opening a proper quantity of the fluid metal. He then immediately lets fall the upper stone, and by that means forms the lead into a thin irregular plate, which is afterwards cut into a proper shape. The surfaces of the stone, where they touch each other, are exactly ground together."*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

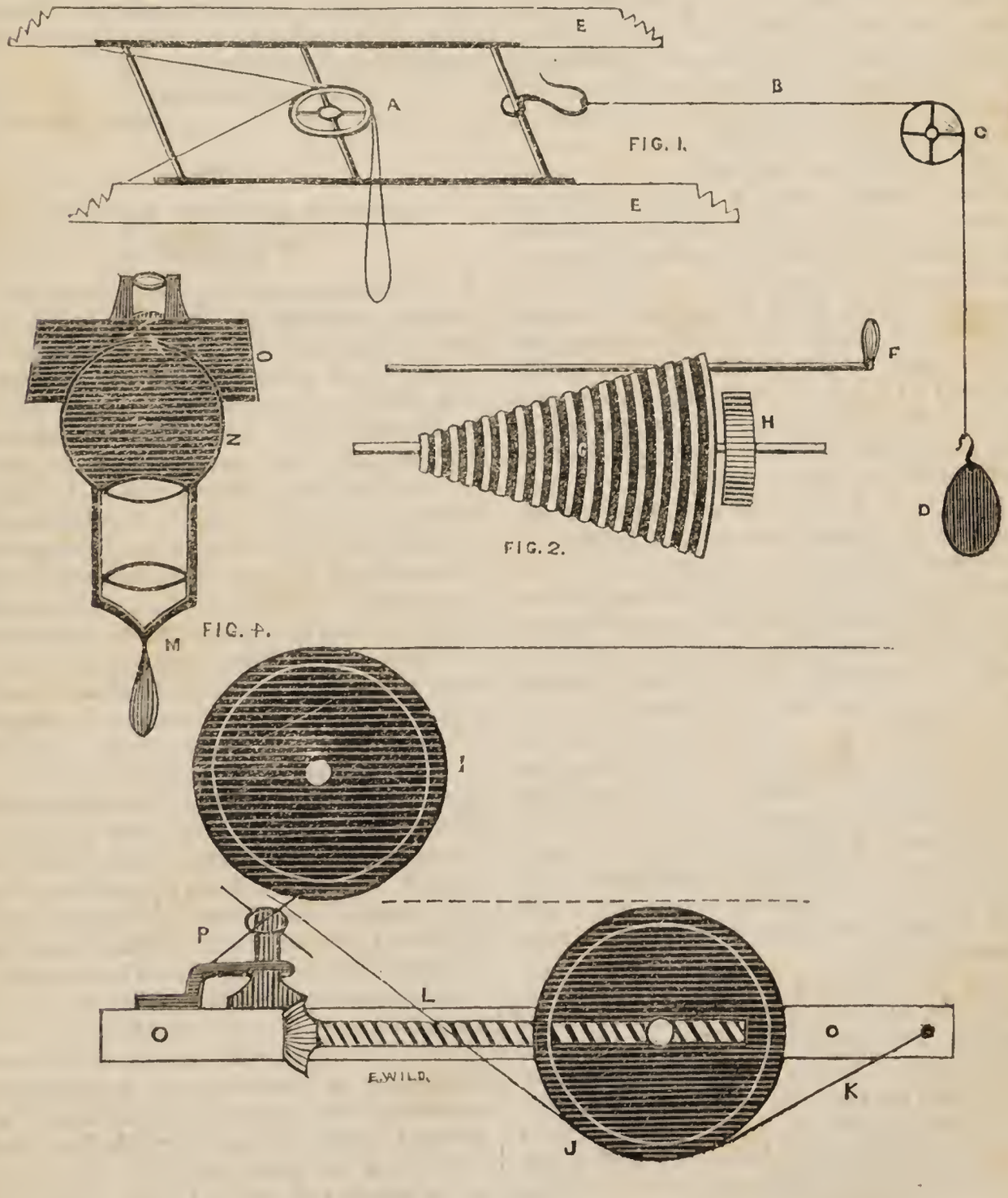
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 109, THIRD SERIES. | SATURDAY, NOV. 12, 1842. | No. 357, OLD SERIES.

SURFACE LATHE.



Vol. VIII.—No. 50.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

SURFACE LATHE.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—In No. 103 of the Penny Mechanic, I gave a hasty description of the manner in which I would effect an alteration in the surface lathe, in order to give a suitable movement for surface turning; the accompanying drawing will at once explain my views contained in that letter.

Description of the Engravings.

Fig. 1 represents the over-head sliding motion, laid between two joists or rails, and, at the same time, may be kept in its place by strips of wood or angle iron, that it may advance and recede without being thrown out of its place. A are two pulleys, over which the band works; B, a cord thrown over pulley, G, with the weight, D, to advance the frame or slide, and thereby tighten the band; E, the joists or rails, to support the frame.

Fig. 2 is the conical pulley, on the back-motion spindle, with a great number of grooves, and those very shallow, that the band may more easily be moved from one groove to the other, by means of the lever, F, which lever must be worked in a slot at each end, that it may not be canted out of its place by the band; and it might be as well to have as many notches or pin-holes in the lever, as there are grooves in the pulley, and advance them, one by one, as the occasion may require.

Fig. 3 is a separate and distinct arrangement from that contained in the letter above referred to; I is a pulley, keyed on the spindle of the back-motion spindle; J, another pulley, which may be drawn up and down by means of the screw, L, with a connexion of two bevel wheels, where a motion may be obtained by means of the tape, P; K is the band passed round each of the pulleys, and thence over the pulleys of the slide in fig. 1; and thus, by lowering the pulley, J, a slower motion is obtained. But, probably, many of your ingenious correspondents, who have more time to write and think than myself, will add farther improvements to this very desirable object.

Fig. 4 contains a tool for ball turning, partly in answer to your ingenious and zealous correspondent, "An Amateur Mechanic." M is a steel tube, turned or bored out particularly true, and not more than the $\frac{3}{32}$ of an inch thick, with a handle; it must be hardened and made perfectly square and smooth at the cutting end. O is a leaden chuck recess, to receive the ball, N, which ball is kept in the chuck by means of the tool being held against it. A rotary motion must be given to the tool in the hand, which will be imparted to the ball in the chuck, and thus it will be cut round; and, as the ball is about to be taken out of the lathe, the tool must be very slightly held against it, that the last revolution of the lathe may not leave a mark in the ball. I must observe, that the ball ought to be turned previously to going into the leaden chuck, in order to preserve the tool, which is invaluable, if once brought from its sudden immersion in cold water, at the perfection it went in. And although this may not add to the stock of information of "A. M.," yet I have no doubt but it may be desirable to many of your readers; as but few factories are possessed of them—whether from a want of knowledge of its existence or its usefulness, I know not.

I am yours, &c.,

Geo. Lodge.

MANUFACTURE OF GUN-BARRELS.

A gun-barrel ought to possess the following properties:—Lightness, that it may incommode the person who carries it as little as possible; sufficient strength and other properties requisite to prevent its bursting by a discharge. It ought to be constructed in such a manner, as not to recoil with violence, and to be of sufficient length to carry the shot to as great a distance, as the strength of the powder is capable of doing. The manufacture of fire-arms is now carried to such a degree of perfection, that it may justly be doubted whether any farther improvement in the requisites just mentioned, can be made. For the materials, the softest iron that can be procured is to be used. The best in this country are formed of stubs, as they are called, or old horse-shoe nails, which are procured by the gunsmiths from farriers, and from poor people who subsist by picking them up on the principal roads. These are sold at about 10*s.* per cwt.; and 28lbs. are sufficient to form a single musket barrel. The method of manufacturing them from this material is as follows:—A hoop of about an inch broad, or about six or seven inches in diameter, is placed in a perpendicular situation, and the stubs, previously well cleaned, piled up in it, with their heads outermost on each side, till the hoop is quite filled and wedged tight with them. The whole then resembles a rough circu-

lar cake of iron, which, being heated to a white heat, and then strongly hammered, coalesces into one solid lump. The hoop is now removed, and the heatings and hammerings repeated till the iron is rendered very tough and close in the grain, when it is drawn out into pieces of about twenty-four inches in length, half-an-inch or more in breadth, and half-an-inch in thickness. Four of these pieces are employed for one barrel; but, in the ordinary way, a single bar of the best soft iron is employed. The workmen begin with hammering this out into the form of a flat ruler, having its length and breadth proportioned to the dimensions of the intended barrel. By repeated heating and hammering, this plate is turned round a mandril, the diameter of which is considerably smaller than the intended bore of the barrel. One of the edges of the plate being laid over the other about half-an-inch, the whole is heated and welded by two or three inches at a time, hammering it briskly, but with moderate strokes, upon an anvil which has a number of semicircular furrows in it, adapted to barrels of different sizes. Every time the barrel is withdrawn from the fire, the workman strikes it gently against the anvil once or twice, in a horizontal direction. By this operation, the particles of the metal are more perfectly consolidated, and every appearance of a seam in the barrel is obliterated. The mandril being then again introduced into the cavity of the barrel, the latter is very strongly hammered upon it, in one of the semicircular hollows of the anvil, by small portions at a time; the heatings and hammerings being repeated, until the whole barrel has undergone the operation, and its parts rendered as perfectly continuous, as if they had been formed out of a solid piece. To effect this completely, three welding heats are necessary, when the very best iron is made use of, and a greater number for the coarser kinds. The French workmen imagine that, by giving the barrel, while in the fire, slight horizontal strokes with the hammer, so as to communicate a vibratory motion to the iron, those particles are thrown off which are in a state of fusion, and cannot be easily converted into malleable iron; but, considering the great number of operations already described, which the metal has undergone, we can scarcely suppose this to be of much consequence.

(To be continued.)

HISTORY OF MEDALS.

(Continued from page 389.)

The diadem is worn by most of the Greek queens, by Orodaltis, daughter of Lycomedes, king of Bithynia; and though the Roman empresses never appear with it, yet this is more than compensated by the variety of their head-dresses. Sometimes the bust of an empress is supported by a crescent, to imply that she was the moon, as her husband was the sun, of the state. The toga, or veil drawn over the face, at first implied that the person was invested with the pontifical office; and, accordingly, we find it on the busts of Julius Cæsar, while pontifex maximus. It likewise implies the augurship, the augurs having a particular kind of gown, called lana, with which they covered their heads when observing an omen. In latter times, this implies only consecration, and is common in coins of empresses. It is first met with on the coins of Claudius Gothicus, as the mark of consecration of an emperor. The nimbus, or glory, now appropriated to saints, has been already mentioned. It is as ancient as Augustus, but is not to be met with on many of the imperial medals, even after it began to be appropriated to them. There is a curious coin, which has upon the reverse of the common piece, with the head of Rome, "Urbs Roma," in large brass, Constantine I., sitting amid victories and genii, with a triple crown upon his head for Europe, Asia, and Africa, with the legend "Securitas Romæ."

In general, only the bust is given upon medals, though sometimes half the body or more; in which latter case, the hands often appear with ensigns of majesty in them; such as the globe, said to have been introduced by Augustus as a symbol of universal dominion; the sceptre, sometimes confounded with the consular staff; a roll of parchment, the symbol of legislative power; and a handkerchief, expressive of the power over the public games, where the emperor gave the signal. Some princes hold a thunderbolt, showing that their power on earth was equal to that of Jupiter in heaven, while others hold an image of Victory.

Medals likewise afford a good number of portraits of illustrious men; but they cannot easily be arranged in chronological order; so that a series of them is not to be expected. It is likewise vain to attempt the formation of a series of gods and goddesses to be found on ancient coins. Mr. Pinkerton thinks it much better to arrange them under the several cities or

kings whose names they bear. A collection of the portraits of illustrious men, may likewise be formed from medals of modern date.

The reverses of ancient Greek and Roman coins, afford an infinite variety of instruction and amusement. They contain figures of deities at full length, with their attributes and symbols, public symbols and diversions, plants, animals, &c., and, in short, almost every object of nature or art. Some have the portrait of the queen, son, or daughter of the prince whose image appears on the face obverse; and these are esteemed highly by antiquaries, not only because every coin stamped with portraits on both sides is accounted valuable, but because they render it certain that the person represented on the reverse was the wife, son, or daughter of him who appears on the obverse; by which means they assist greatly in the adjusting of a series. Some, however, with two portraits, are common—as Augustus, the reverse of Caligula; and Marcus Aurelius, reverse of Antoninus Pius.

We find more art and design in the reverses of the Roman medals than of the Greek; but, on the other hand, the latter have more exquisite relief and workmanship. The very ancient coins have no reverses, excepting a rude mark struck into the metal, resembling that of an instrument with four blunt points, on which the coin was struck; and was owing to its having been fixed by such an instrument on that side to receive the impression upon the other. To this succeeds the image of a dolphin, or some small animal, in one of the departments of the rude mark, or in a hollow square: and this, again, is succeeded by a more perfect image, without any mark of the hollow square. Some of the Greek coins are hollow in the reverse, as those of Caulonia, Crotona, Metapontum, and some other ancient cities of Magna Græcia. About 500 years B. C., perfect reverses appear on the Greek coins, of exquisite relief and workmanship. "The very muscles of men and animals," says Mr. Pinkerton, "are seen, and will bear inspection with the largest magnifier, as ancient gems. The ancients certainly had not eyes different from ours; and it is clear that they must have had magnified objects. A drop of water forms a microscope; and it is probable this was the only one of the ancients. To Greek artists we are indebted for the beauty of the Roman imperial coins; and these are so highly finished, that, on some reverses, as that of Nero's decursion, the *adventus* and *progressio* of various emperors, the *fundator pacis* of Severus, the features of the emperor, riding or walking, are as exact as on the obverse. But though the best Greek artists were called to Rome, yet the Greek coins under the Roman emperors are sometimes well executed, and always full of variety and curiosity. No Roman or Etruscan coins have been found of the globular form, or indented, on the reverse, like the early Greek. The first Greek are small pieces of silver, while the Roman are large masses of copper. The former are struck; the latter cast in moulds. The reverses of the Roman coins are very uniform—the prow of a ship, a car, or the like, till about the year 100 B. C., when various reverses appear on their consular coins in all metals. The variety and beauty of the Roman imperial reverses are well known. The medallist much values those which have a number of figures; as the *Puellæ Faustinianæ*, of Faustina, a gold coin no larger than a sixpence, which has twelve figures; that of Trajan, *regna assignata*, has four; the *congiarium* of Nerva, five; the allocution of Trajan, seven; of Hadrian, ten; of Probus, 12. Some Roman medals have small figures on both sides—as the *Apollini sancto* of Julian II. Such have not received any peculiar name among the medallists. Others have only a reverse, as the noted *spintriati*, which have numerals, I., II., &c., on the obverse."

The names of the deities represented on the reverses of Greek coins, are never expressed; perhaps, as Mr. Pinkerton supposes, out of piety, a symbolical representation of their attributes being all that they thought proper to delineate; but the Roman coins always express the name, frequently with an adjunct—as "Veneri Victrici," &c. In others, the name of the emperor or empress is added—as "Pudicitiæ Augustæ," round an image of modesty; "Virtus Augusti," a legend for an image of virtue.

(To be continued).

Ornament for Glass or Slate.—Spread on a plate of glass a few drops of nitrate of silver, diluted with double its quantity of rain water; place at the bottom of it, and in contact with the fluid, a zinc or copper wire, bent in any form you please, and let the whole remain undisturbed in a horizontal position; in a few hours a beautiful crystallization of metallic silver will arrange itself around the wire, and continue to increase until the whole of the fluid has been acted on by the wire.

REVIEW.

A Record of Patent Inventions; being a Monthly Abstract of all Specifications of Patents of Inventions; to which is added a List of New Patent Cases, Scientific Notices, &c. With plates. By Mr. ALEXANDER PRINCE. No. I.; 8vo., pp. 80. London: W. Lake.

WITHOUT disparaging those journals which are more exclusively devoted to the literature of patents, we hail, with sincere gratification, the appearance of this new candidate for public patronage; because we feel very strongly, that such a periodical abstract of specifications as the "Record of Patent Inventions" will supply, must prove of very considerable value to a numerous class of readers, men of science theoretically engaged in the pursuit, inventors and engineers, as well as practical machinists of every grade.

The importance of *early* and accurate information as regards patents, is a point too obvious to every one at all familiar with the history of inventive genius, to require any illustration at our hands; but we may observe, in passing, that one principal and glaring defect in all the established patent journals is, that, by some singular mismanagement, the specifications are allowed to accumulate so enormously, as to be months in arrear; hence information which would have been of paramount interest in the month of January, ceases to be so in September or October. Now "the main object of the publication before us is, to give a regular abstract of *all* specifications of patents of inventions enrolled. Hitherto, this most important desideratum has been but partially attended to, whereby the nature of many patented inventions is totally unknown, particularly such as have only been worked in private, or are altogether dormant; and manufacturers frequently find, after great outlay of capital, that they have been infringing upon some patentee's right, entirely from ignorance of its existence. To remedy this evil," the editor informs us, "is the object of the present work."

A very curious and instructive chapter in the great book of human character, might be gleaned from the files of the Patent Office. Of the thousands that have been granted during the present century, how many, or, rather, how few have proved beneficial either to the inventor or the public? The great mass are forgotten, or remembered only as monuments of misdirected talent! Again, some of the most successful of modern patents are notoriously based on neglected or apparently obsolete inventions; a species of misappropriation that never could have happened, if an honest and faithful record of patent inventions had been then in existence.

Our readers will, we apprehend, be enabled to form a tolerably correct estimate of the character and scope of the undertaking, by a brief sketch of the number before us, when we state, that it contains abstracts sufficiently copious, of *twenty-eight* specifications, besides a report of the law proceedings in the case of Bynner's patent. We think we have advanced sufficient to justify an opinion, in which we trust there are few or none of our readers who will not heartily coincide, that this being a periodical occupying a vacant space in our scientific literature, is calculated to render essential service to all who are interested, however remotely, in patent rights.

MISCELLANEA.

Gas from Grapes.—The *Courier du Midi* states, that for some evenings the town of Montpellier had been lit with gas proceeding from the lees of grapes. The light was clear and brilliant, and could not be distinguished from that of coal gas, except by a somewhat greater intensity. The journal adds, however, that the grape-lees were not used alone, but has omitted to state what carbonaceous substance was employed to give the illuminating power.

Mining Experiments at Chatham.—Some very interesting experiments, illustrating the methods of blowing up stockades, bridges, counterscarps, &c., and also exhibiting the mode of attack with hand-grenades, &c., were exhibited, on Monday, on the engine-ground for field practice at Chatham. The first operation—viz. what in military phrase is called breaching a stockade by bags of gunpowder—commenced shortly after one o'clock, when Lieutenant King placed his charge, consisting of four bags of gunpowder, each bag containing 60 lbs., on the west side of a stockade of great strength, erected for the purpose; three bags of powder being placed on the lower tier, and one on the upper. The hose was attached to the middle bag of the lower tier, and the other end passed through the stockade to the east side, two inches of portfire being attached. The bugle having given the signal to fire the train, it was lit. The experiment was

perfectly satisfactory; the explosion took place within two minutes of the light being applied to the portfire, and the stockade was riven in pieces. The next operation was the attack of a block-house, similar to those erected in American warfare, by a party under Lieut. Grant, with hand-grenades. The party consisted of forty men, who threw the combustibles into the block-house, and then retreated behind the adjoining parapets, until the destructive missiles burst within the devoted building, and exhibited their force, by tearing the planks of which it was constructed, into holes and fissures. The third operation was the blowing off the crown of the arch of a strongly-built brick bridge, which was accomplished with success by a minimum charge of gunpowder. The effect of this operation was magnificent, the explosion was terrific. The brickwork was hurled several hundred feet into the air, and the fragments carried to a distance of several hundred yards. Two operations upon the piers of the bridge were then performed with equal success, and the whole mass was overthrown amidst loud explosions. The last operation—the blowing away a portion of a counterscarp, in order to enable the depression of guns to an angle to bear upon a battery—was the most curious. This operation was, like the others, completely successful. The earth was blown away with a tremendous noise and force, and the object intended fully accomplished.

Steam-baked Bread, à la Vienna.—It has been known for some time at Vienna, that if the hearth of an oven be cleaned with a moistened wisp of straw, bread baked therein immediately afterwards presents a much better appearance, the crust having a beautiful yellow tint. It was thence inferred, that this peculiarity must be attributed to the vapour, which, being condensed on the roof of the oven, fell back on the bread. At Paris, in order to secure with certainty so desirable an appearance, the following arrangement is practised:—The hearth of the oven is laid so as to form an inclined plane, with a rise of about eleven inches in three feet, and the arched roof is built lower at the end nearest the door, as compared with the farthest extremity. When the oven is charged, the entrance is closed with a wet bundle of straw. By this arrangement, the steam is driven down on the bread, and a golden-yellow crust is given to the bread, as if it had been previously covered with the yolk of an egg.—*Foreign Correspondent of the Annals of Chemistry.*

Eminence attained by Men of Low Origin.—Many of the most eminent men in literature, science, and art, have sprung up in obscurity. Some will instantly occur to the mind, from among the living as well as the dead, who have laid society under the deepest obligations: but there are others whose claims are not so commonly remembered. It is calculated, for instance, that above a million and a half chaldrons of coals are annually consumed in London; and the amazing extension of the coal trade to meet such demand, is to be traced to men called "viewers," who have generally raised themselves from lower situations. Machinery was absolutely necessary to obtain so many millions of tons of one of the first necessaries of life, and that at a rate exceedingly low; and this was provided by Newcomen, the plumber, and Smeaton and Watt, the watchmakers. The cheap and elegant garments, which give bread to about two millions of people, instead of fifty thousand, which raised the importation of cotton wool from less than 2,000,000 lbs. to 200,000,000 lbs. per annum, and which increased the annual produce of the manufacture from £200,000 to £36,000,000, are to be traced, through subsequent improvements, to Arkwright and Crompton, the barbers. A rude and inconsiderable manufacture was changed into an elegant art, and an important branch of national commerce, by Wedgwood, the potter. Inland navigation, which enabled manufacturers to import the raw materials and export the finished goods, was devised and executed by Brindley, the millwright; and it would be easy to accumulate a great number of instances in which persons of humble grade have greatly promoted the general good.—*Wilderspin's Early Discipline*, p. 268.

Turnip-Fly.—A correspondent of the *Mark Lane Express* describes the following as a simple and efficacious remedy for checking the ravages of this destructive insect:—"In my constant intercourse with farmers, I have frequently heard their lamentations on the destructiveness of the turnip-fly. A small patch of turnip-seed was sown in my garden some weeks since, and I thought no more of it for a considerable time; till one day, chancing to pass by it, I discovered, on close inspection, that the young plants were swarming with fly, which had already half destroyed them. I lost no time in applying what I hoped would be a remedy for the mischief: this consisted of some stale liquid from a lime-pit scattered over the

plants with a watering pot. On revisiting the patch the next day, I found that the enemy was gone, and scarcely a fly was to be seen, except one solitary little wretch that was perched on a plant just unfolding, but not one could be seen on any plant that had received a sprinkling from the contents of the watering-pot. The next apprehension was, that the sprinkling might have injured the plants; a few days, however, removed all doubt, for rain came and washed the sprinkling (of lime and animal matter in combination) from the plants down to the roots, and they have since grown away in rank luxuriance, have been thinned once, and require the same operation again. Thus, by sprinkling, the plants received protection from the fly, and, when the rain fell, were nourished by a highly stimulating manure. It will, however, be said—but of what avail is this information?—farmers have not access to the lime-pits of the tanner; and, if they had, the quantity to be procured would be so small as not to be of any material benefit; which is very true, and, therefore, the writer would recommend every farmer to have his own lime-pit in his farm-yard. If so situated as to take the drainings of the yard, all the better; or, where water may be obtained, a bricked pit or tank, into which should be thrown a few quarters of lime, with a sufficiency of water; and, where it can be procured, all manner of refuse animal matter, cut in pieces—such as dead sheep, carrion, &c., and the entrails of what may be slaughtered. Sometimes, on the coast, a load of worthless fish may be obtained. Farmers are little aware what an amount of rich liquid manure may be obtained at a very trifling cost. Although not one myself, I know, from the effects produced at various times on a small scale in my garden, that animal matter in solution with lime, is an active and powerful manure; and what induced me to think it might be a preventive to fly was, that I had observed, however stale and fetid, animal life cannot exist in it."

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, November 16, James Smith, Esq., on Political Economists and their Doctrines. Friday, November 18, T. Williams, Esq., on the Organs of Support and Locomotion in Man and the lower Animals. At half-past eight precisely.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, November 14, Thomas Tagg, Jun., Esq., on The Love of Praise, Melancholy, &c. At a quarter-past eight o'clock.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, November 17, Thomas James Serle, Esq., on the Plays and Characters of Shakspeare. At half-past eight o'clock.

QUERIES.

The simplest plan for striking the different kinds of Gothic arches? H. P.

How the slides are passed in the magic lantern, to obtain the dissolving view? C.

1. How can I make, and what size should a camera for calotyping portraits from life be; the kind of object-glass, &c.? The cameras at Palmer's, of Newgate Street, have an object-glass (to the end of a tube) composed of three glasses, is that necessary? If so, would a telescope object-glass do for the purpose; having two achromatic object-glasses by me, I should like the most effective article while I am about it? 2. I wish to know the kind of apparatus employed for the Daguerreotype, either Beard's or Claudet's, and the manner of using it? 3. How can I remove the stain of pickled-salmon liquor from a drab cashmere shawl? Washing has not had the effect? Z.

Why does lacquer turn dull and clouded, when put on plain brass-door knobs, &c.? Having had application to make a sausage-meat cutter or chopper, one that will be applicable to the power of one hand, to be fitted with three or four cutters, with the single knife, if any of your correspondents will supply the information, with a descriptive drawing, they would greatly oblige J. B. F.

"G. Starkey." In the engraving of the oxy-hydrogen blowpipe, fig. 3, near the top there is a point, D, passing through; is the lime fixed on this point, so that the mixed gases can play on it? J. B. F.

What should be the dimension and shape of the boiler to a small model of a stationary steam-engine high pressure, for a charcoal fire? The cylinders are three inches and a half long, and two inches wide, inside measure. J. D.

G. S., jun." was particularly requested, a few weeks since, to favour "S. E." with the "mechanical arrangement for causing the pedals of an organ to act upon the keys; likewise for connecting two rows." "S. E." has not had his request granted; consequently, he again solicits the favour, trusting the obligation may be conferred.

I wish to gild a few letters upon a piece of painted card; can any of your correspondents inform me of the best method of doing so?
T. WHITELOCK.

By what process is the refined resin obtained for the use of violin players? I have some at this time as clear as crystal, of a fine

auburn colour, and gives a fine floury whiteness to the bow, and does not cause the hair to hang and break, as in the common resin.

W. Whiddon.

Never having met with, in any work, an account elucidating the cause of the erasion of black-lead pencil marks by caoutchouc, without, on its being used again, soiling the paper, I avail myself of your excellent Magazine, through the medium of which I hope to gain some information on the subject. Perhaps, should this meet the eye of your able correspondent, "J. Mitchell," he will kindly answer it. The first idea that struck me as the cause was this—That, on the friction of paper by caoutchouc, electricity is given off, and that, as substances similarly electrified, repel each other, the carburet of iron and the paper taking this condition, the carburet is dispersed, and the caoutchouc, consequently retaining none of the extraneous matter, performs its duties for any length of time, without soiling the paper, &c. Linseed oil, by exposure to the atmosphere for some time, becomes hardened, and acquires all the properties of caoutchouc, and, in all probability, the same explanation will suffice for both.

J. G. T.

Can any of your readers inform me the address of a person who makes the musical tongues used in accordions? G. S.

Having seen in a back No. of your Journal, that a correspondent has a small lathe to dispose of, I beg to say that, unless it be already sold, I shall be happy to treat with him for it, and shall, therefore, feel obliged by receiving his address. J. Wilkins.

How to make the black japan used so much in turned goods? A. Y. T.

Some time since I made an application for a process of bluing steel, which was answered by a correspondent signed "Amateur Mechanic," in which he informs me he has a full statement of a plan that will probably suit me, which he can get copied for a small sum. If he will inform me the amount, and how and where I am to get it (if the price be not too much), I shall be greatly obliged to him. He can inform me through your Journal, or by post. The articles I want to blue, are small springs.

J. Reid.

31, Warren Street, Tottenham Court Road.

Being engaged in making some experiments with a small battery of four half-pint jars, on Smee's plan, I want to fire some powder, about three inches from the battery, not under water, but cannot succeed. Would any of your correspondents be kind enough to inform me of the cause of my failure? I have tried a platina wire one-fortieth, one-two hundredth, and one-four hundredth of an inch in diameter, but cannot get any one of them warm. And I find, after having it in use twenty-four or thirty hours, something gets on the platinized silver; I think it is zinc. J. R.

The best work on the locomotive engine? Also, what substance is generally used for thickening the hair? M. J.

1. How to make a composition to imitate mother-of-pearl, such as is used to inlay with? 2. What can I use, instead of glue or gum, with the flock for papier-mache? I want something that will set directly. Resin will not answer; it is too brittle and combustible. I would rather that it should be dissolved by heat, and must be cheap. 3. How to make common resin stronger and less brittle, without making it soft? 4. What are the bitumens composed of, such as are used to pave the streets? T. Y. S.

1. How to make the strongest kind of marine glue that will not be injured by frost, heat, or moisture? 2. A recipe for making a superior polishing powder for cleaning gold, silver, and plated articles of all kinds? 3. The most effectual method of preventing boots or shoes from creaking; to be used either at the time of making, or at any time afterwards? 4. How is caoutchoucine made, and where can I obtain it and other chemicals of first-rate purity? O. M.

What is the composition of meal-powder, which is so much used in manufacturing fireworks? 2. What are products of the combustion of gunpowder? 3. The specific gravity of tin, palladium, and muriatic acid? 4. The composition of blood from the arteries, and how it differs from venous blood?

A. L. S.

If any of your readers should be in want of a powerful Smee's battery, nearly six inches by four inches, for the small price of 8s., direct to "A. D., care of Mr. Bartlett, Britain Terrace, King's Road, Chelsea. To purchase the same at the shops, would cost from 12s. to 15s.

ANSWERS TO QUERIES.

"J. W." Glass should be bedded on fresh-made plaster of Paris, and, when set, should be ground with a piece of tin plate for a rubber, with fine emery or sand and water; after which should be cleared round the edge of glass, and slips of tin plate gently put under to raise the glass.

"N. M. T." Ovals can readily be formed as follows:—Drive two nails (sixpenny will do) into a flat surface; the distance from nail to nail will depend on the size of the oval required; then stretch a string, tied at its ends, forming an endless band from nail to nail, loosely; then by placing a pencil inside of the band, and pressing against the string, you will make an oval on the board.

W. Z.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

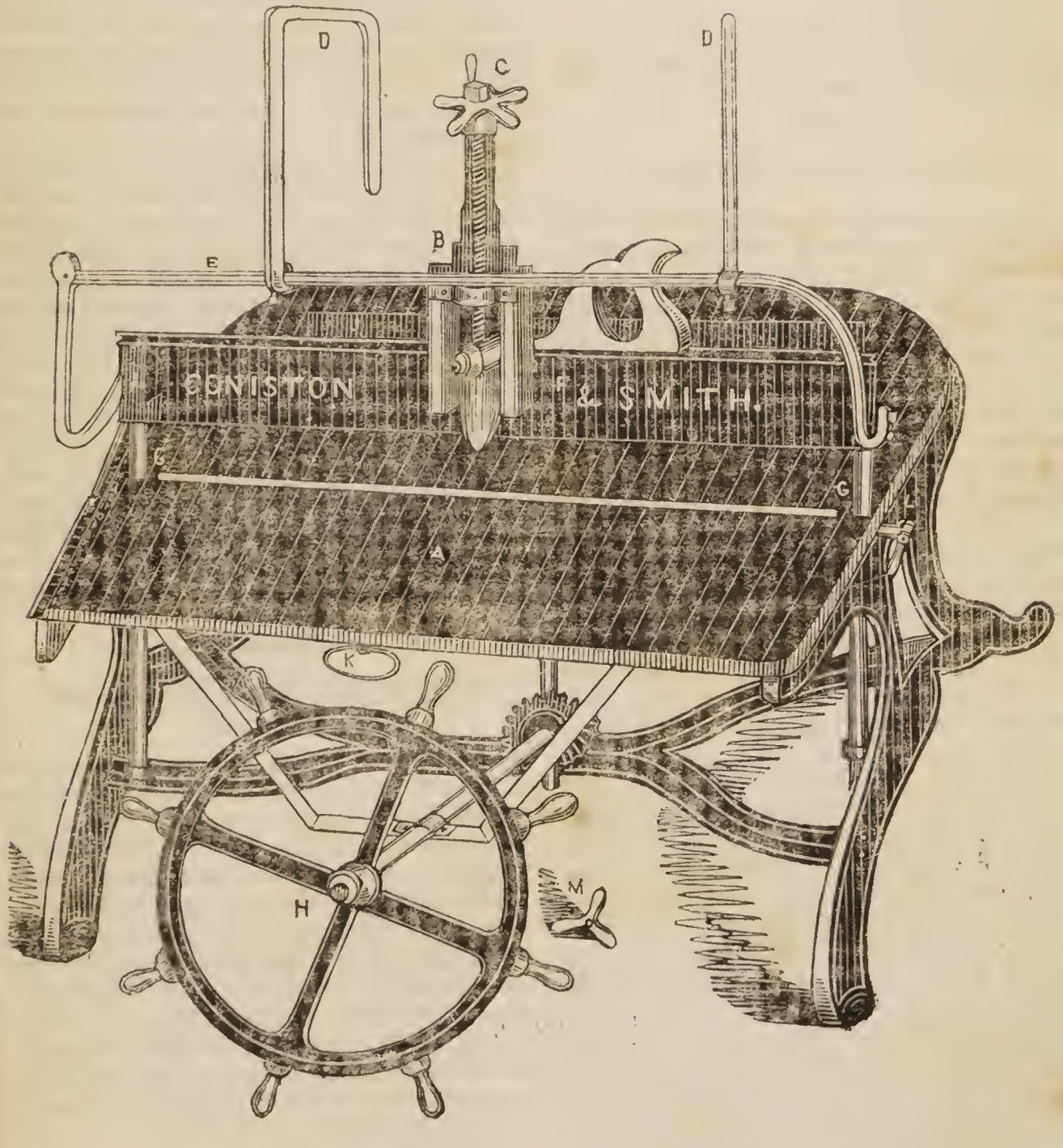
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 110, THIRD SERIES. | SATURDAY, NOV. 19, 1842. | No. 358, OLD SERIES.

CONISTON'S IMPROVED CUTTING-MACHINE.



Vol. VIII.—No. 51.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

CONISTON'S IMPROVED CUTTING-MACHINE.

(See Engravings, front page.)

Description of the Engraving.

A, the table.

B, the plane in which is fixed the knife.

C, the cross, with screw.

D D, two tapets, which move the cross and screw, and brings down the knife.

E, the bar on which the tapets move.

F, the head.

G G, the rods which raise and fall the head to press the paper, and which are worked by

H, the cross.

I, the inch gauge.

J, the back gauge, worked by

K, the handle.

L, set screw for gauge.

M, triangular cross for quickening the motion of the knife.

PERSPECTIVE DRAWING.

In order properly to understand the principles of perspective, it is always necessary to consider the plane on which the representation is to be made as transparent, and interposed between the eye of the spectator and the object to be represented. Thus, suppose a person at a window looks through an upright pane of glass at any object beyond, and, keeping his head steady, draws the figure of the object upon the glass with a black-lead pencil, as if the point of the pencil touched the object itself; he would then have a true representation of the object in perspective, as it appears to his eye.

In order to this, two things are necessary:—First, that the glass be laid over with strong gum-water, which, when dry, will be fit for drawing upon, and will retain the traces of the pencil; and, secondly, that the person look through a small hole in another plate of metal, fixed about a foot from the glass between it and his eye, and that he keep his eye close to the hole, otherwise he might shift the position of his head, and, consequently, make a false delineation of the object. Having traced over the figure of the object, he may go over it again with pen and ink, and, when that is dry, put a sheet of paper upon it, and trace it thereon with a pencil; then, taking away the paper, and laying it on a table, he may finish the picture, by giving it the colours, lights and shades, as he sees them in the object itself; he will then have a true resemblance of the object.

To every person who has a general knowledge of the principles of optics, this must be self-evident; for, as vision is occasioned by pencils of rays coming in straight lines to the eye from every part of the visible object, it is evident that, by joining the points in the transparent plane, through which all these pencils respectively pass, an exact representation must be formed of the object as it appears to the eye in that particular position, and at that determined distance. And were pictures of things to be always drawn, first on transparent planes, this simple operation, with the principle on which it is founded, would comprise the whole theory and practice of perspective. As this, however, is far from being the case, rules must be deduced from the science of optics and geometry, for drawing representations of visible objects on opaque planes; and the application of these rules constitutes what is properly called the art of perspective.

The theory of perspective consists in this—that when a person stands against the middle of one end of a long avenue or walk, which is straight and equally broad throughout, the sides thereof, seem to approach nearer and nearer to each other, as they are farther and farther from his eye. The angles under which their different parts are seen, become less and less, according as the distance from his eye increases; and if the avenue be very long, the sides of it, at the farthest end, will seem to meet; and there an object, that would cover the whole breadth of the avenue, and be of a height equal to that breadth, would appear only to be a mere point.

INVENTION OF THE PIANO-FORTE.

The great object in the construction of musical instruments, is to bring them, as nearly as possible, to express the sound produced by the human voice. The violin, however, and a few of the simple wind instruments, are the only ones found fully to express these momentary gradations of sentiment, and those tender and delicate emotions with which the heart is agitated. For the purpose of removing this defect of harmonic instruments, the swell was added to the organ. Similar improvements were also attempted on other instruments of the same kind.

The harpsichord was shut up like the swell organ, and was opened by means of pedals, when the performers wished to enforce the sound. But as this was found

not to succeed well, other methods were tried, and, in particular, unisons were added to each note, which were wrought on either by means of pedals or another set of keys; and, in this way, the power of the harpsichord was greatly improved. Among all the keyed instruments, the English pianoforte seems to merit the preference, on account of the superior force of tone, adequate sweetness, and great variety of voice, of which, by the ingenuity of British artists, it has now become susceptible. It has been called a national instrument, because it is said to be an English contrivance—the invention of the celebrated poet, Mason. Mr. Mason had seen some attempts, which were made by the Germans, to make keyed dulcimers, which were, in some measure, susceptible of the *forte* and *piano;* but as they were all constructed on one principle, and required a particular touch of the finger, which was of difficult acquisition, and which spoiled it for harpsichord practice, as they were also deficient in delicacy and justness, and as the performer was by no means certain of producing the very strength of sound intended, Mr. Mason removed all those imperfections, by detaching the mallet entirely from the key, and giving them only a momentary connexion. It is by this improvement that the English pianoforte is distinguished from all others. In respect to the solidity and precision of workmanship, the British instruments are unrivalled, and vast numbers are continually being sent to all parts of the Continent.

INK TO WRITE ON ZINC.

To the Editor of the Penny Mechanic and Chemist.

Sir,—After repeated attempts a few months ago, to manufacture an ink to write on zinc, that would stand the action of the weather, I succeeded, at last, by employing the following:—Nitrate of cupri (copper), 1 drachm; hydro-chlorate of ammonia (sal ammoniac), 2 drachms; lamp black, 2 scruples; aqua, 4 ounces. This ink will be found superior to any other to write on zinc. For labels, the floriculturist will find it extremely useful; the ink flowing from the pen as readily as any other writing fluid.

I remain, yours &c.,

G. Starkey.

SUGGESTED IMPROVEMENTS ON THE KEYS OF PIANOFORTES AND ORGANS.

By Lewis Gompertz.

A suggestion has occurred to offer increased facility of execution on the pianoforte and organ, by having the notes or keys square, and arranging them so, that they occupy a space of considerable breadth, as well as length, exactly like a draught-board; by which means, we might have all the notes in a very small and nearly square space, instead of a long row; and a space of about five inches long and seven deep, would be enough for above eight octaves, instead of having a row of keys about three inches and a half long. The advantages would not only be the saving of room, but more particularly that of having all the notes near to each other, and of preventing the necessity of shifting, except by means of a progressive motion of the fingers upwards or downwards; and that very little variation of fingering would be required. By this plan, the hand could span from one end of the instrument to the other; and intervals and chords which, on another instrument, are of the greatest stretch, would lie quite close, while all the keys of the scale could be played on with equal ease. Some difficulty would, however, present itself, in taking intervals together, one lying over the other; but in this case, the two notes must be taken with one finger, or any other arrangement of the notes may be observed, if preferred. The mode by which the plan could be applied to the strings, has not yet been considered; but no great difficulty appears likely to present itself to its accomplishment.

COPYRIGHT OF DESIGNS ACT.

The following extract from the new Act relating to the amendment of the law of copyright of designs, will, we think, be sufficient to explain to those of our readers and correspondents who have for some time requested information on the subject, the true meaning and intent of the same. The Act came into operation on the 1st of September last; but every copyright which was in force under the before-existing Acts, is allowed to continue in force until the expiration of such copyright; with the exception, that all penalties imposed with respect to any offence or injury committed against such copyright, shall only be applicable as if such copyright had been conferred by the new Act. To those of our readers who may require

more explicit information, we would recommend "Robertson's Copy of the Act, with Explanatory Notes, Directions, &c.," published at 166, Fleet Street.

"With regard to any new and original design (except for sculpture and other things within the provisions of the several Acts mentioned in the Schedule (C.) to this Act annexed), whether such design be applicable to the ornamenting of any article of manufacture, or of any substance, artificial or natural, or partly artificial and partly natural; and that whether such design be so applicable for the pattern, or for the shape or configuration, or for the ornament thereof, or for any two or more of such purposes, and by whatever means such design may be so applicable, whether by printing, or by painting, or by embroidery, or by weaving, or by sewing, or by modelling, or by casting, or by embossing, or by engraving, or by staining, or by any other means whatsoever, manual, mechanical, or chemical, separate or combined; be it enacted, that the proprietor of every such design, not previously published either within the United Kingdom of Great Britain and Ireland or elsewhere, shall have the sole right to apply the same to any articles of manufacture, or to any such substances as aforesaid, provided the same be done within the United Kingdom of Great Britain and Ireland, for the respective terms hereinafter mentioned; such respective terms to be computed from the time of such design being registered according to this Act; that is to say, in respect of the application of any such design to ornamenting any article of manufacture contained in the first, second, third, fourth, fifth, sixth, eighth, or eleventh of the classes following, for the term of three years; in respect of the application of any such design to ornamenting any article of manufacture contained in the seventh, ninth, or tenth of the classes following, for the term of nine calendar months: in respect of the application of any such design to ornamenting any article of manufacture, or substance contained in the twelfth or thirteenth of the classes following, for the term of twelve calendar months:—

Class 1. Articles of manufacture composed wholly or chiefly of any metal or mixed metals.

Class 2. Articles of manufacture composed wholly or chiefly of wood.

Class 3. Articles of manufacture composed wholly or chiefly of glass.

Class 4. Articles of manufacture composed wholly or chiefly of earthenware.

Class 5. Paper-hangings.

Class 6. Carpets.

Class 7. Shawls, if the design be applied solely to printing, or by any other process by which colours are or may hereafter be produced upon tissue or textile fabrics.

Class 8. Shawls not comprised in class 7.

Class 9. Yarn, thread, or warp, if the design be applied by printing, or by any other process by which colours are or may hereafter be produced.

Class 10. Woven fabrics, composed of linen, cotton, wool, silk, or hair, or of any two or more of such materials, if the design be applied by printing, or by any other process by which colours are or may hereafter be produced upon tissue or textile fabrics; excepting the articles included in class 11.

Class 11. Woven fabrics, composed of linen, cotton, wool, silk, or hair, or of any two or more of such materials, if the design be applied by printing, or by any other process by which colours are or may hereafter be produced upon tissue or textile fabrics, such woven fabrics being or coming within the description technically called furnitures, and the repeat of the design whereof shall be more than twelve inches by eight inches.

Class 12. Woven fabrics, not comprised in any preceding class.

Class 13. Lace, and any article of manufacture or substance not comprised in any preceding class.

Conditions of Copyright—Registration before Publication—Articles to have marks denoting Registration.

Provided always, and be it enacted, that person shall be entitled to the benefit of this Act, with regard to any design in respect of the application thereof to ornamenting any article of manufacture, or any such substance, unless such design have before publication thereof been registered according to this Act, and unless at the time of such registration, such design have been registered in respect of the application thereof to some or one of the articles of manufacture or substances comprised in the above-mentioned classes, by specifying the number of the class in respect of which such registration is made, and unless the name of such person shall be registered according to this Act as a proprietor of such design, and unless after publication of such design, every such article of manufacture, or such substance to which the same shall be so applied, published by him, hath thereon, if the article of manufacture be a woven fabric for printing, at one end thereof, or, if of any

other kind or such substance as aforesaid, at the end or edge thereof, or other convenient place thereon, the letters "R," together with such number or letter, or number and letter, and in such form as shall correspond with the date of the registration of such design, according to the registry of designs in that behalf; and such marks may be put on any such article of manufacture or such substance, either by making the same in or on the material itself, of which such article or such substance shall consist, or by attaching thereto a label containing such marks.

Who are to be considered Proprietors.

And be it enacted, that the author of any such new and original design shall be considered the proprietor thereof, unless he have executed the work on behalf of another person for a good or a valuable consideration, in which case such person shall be considered the proprietor, and shall be entitled to be registered in the place of the author; and every person acquiring for a good or a valuable consideration a new and original design, or the right to apply the same to ornamenting any one or more articles of manufacture, or any one or more such substances as aforesaid, either exclusively of any other person or otherwise, and also every person upon whom the property in such design or such right to the application thereof shall devolve, shall be considered the proprietor of the design in the respect in which the same may have been so acquired, and to that extent, but not otherwise.

Piracy of Designs.

And for preventing the piracy of registered designs, be it enacted, that during the existence of any such right to the entire or partial use of any such design, no person shall either do, or cause to be done, any of the following acts with regard to any articles of manufacture, or substances, in respect of which the copyright of such design shall be in force, without the licence or consent, in writing, of the registered proprietor thereof; that is to say, no person shall apply any such design, or any fraudulent imitation thereof, for the purpose of sale, to the ornamenting of any article of manufacture, or any substance, artificial or natural, or partly artificial and partly natural: no person shall publish, sell, or expose for sale, any article of manufacture, or any substance, to which such design, or any fraudulent imitation thereof, shall have been so applied, after having received, either verbally or in writing, or otherwise, from any source other than the proprietor of such design, knowledge that his consent has not been given to such application, or after having been served with, or had left at his premises, a written notice, signed by such proprietor or his agent to the same effect.

Registration may in some cases be Cancelled or Amended.

And be it enacted, that, in any suit in equity which may be instituted by the proprietor of any design, or the person lawfully entitled thereto, relative to such design, if it shall appear to the satisfaction of the judge having cognizance of such suit, that the design has been registered in the name of a person not being the proprietor, or lawfully entitled thereto, it shall be competent for such judge, in his discretion, by a decree or order in such suit, to direct either that such registration be cancelled (in which case the same shall thenceforth be wholly void), or that the name of the proprietor of such design, or other person lawfully entitled thereto, be substituted in the register, for the name of such wrongful proprietor or claimant, in like manner as is hereinbefore directed, in case of the transfer of a design; and to make such order respecting the costs of such cancellation or substitution, and of all proceedings to procure and effect the same, as he shall think fit; and the registrar is hereby authorised and required, upon being served with an official copy of such decree or order, and upon payment of the proper fee, to comply with the tenor of such decree or order, and either cancel such registration, or substitute such new name, as the case may be.

HISTORY OF MEDALS.

(Continued from page 383.)

THE principal symbols of the divine attributes to be met with on the Greek medals, are as follows:—

1. Jupiter is known on the coins of Alexander the Great, by his eagle and thunderbolts; but when the figure occurs only on the obverses of coins, he is distinguished by a laurel crown, and placid bearded countenance. Jupiter Ammon is known by the ram's horn twisting round his ear; a symbol of power and strength, assumed by some of the successors of Alexander the Great, particularly by Lysimachus.

2. Neptune is known by his trident, dolphin, or being drawn by sea horses;

but he is seldom met with on the Grecian coins.

3. Apollo is distinguished by a harp, branch of laurel, or tripod; and sometimes by a bow and arrows. In the character of the Sun, his head is surrounded with rays; but when the bust only occurs, he has a fair young face, and is crowned with laurel. He is frequent on the coins of the Syrian princes.

4. Mars is distinguished by his armour, and sometimes by a trophy on his shoulders. His head is armed with a helmet, and has a ferocious countenance.

5. Mercury is represented as a youth, with a small cap on his head, wings behind his ears and on his feet. He is known by the cap, which resembles a small hat, and the wings. He appears, also, with the caducens, or wand twined with serpents, and the marsupium, or purse, which he holds in his hand.

6. Æsculapius is known by his bushy beard, and his leaning on a club with a serpent twisted round it. He sometimes occurs with his wife Hygeia, or Health, with their son Telesphorus, or Convalescence, between them.

7. Bacchus is known by his crown of ivy or vine, his diadem and horn, with a tiger and satyrs around him.

8. The figure of Hercules is common on the coins of Alexander the Great, and has frequently been mistaken for that of the prince himself. He appears sometimes as a youth, and sometimes with a beard. He is known by the club, lion's skin, and remarkable apparent strength; sometimes he has a cup in his hand; and a poplar tree, as a symbol of vigour, is sometimes added to the portrait.

9. The Egyptian Serapis is known by his bushy beard, and a measure upon his head.

10. Apis is delineated in the form of a bull, with a flower of the lotos, the water lily of the Nile, supposed by Macrobius to be a symbol of creation; and Jamblichus tells us, that Osiris was thought to have his throne in it.

11. Harpocrates, the god of Silence, appears with his finger on his mouth; sometimes with the sistrum in his left hand; a symbol common to most of the Egyptian deities.

12. Canopus, another Egyptian deity, appears in the shape of a human head, placed on a kind of pitcher. "This deified pitcher," says Mr. Pinkerton, "seems to refer to an anecdote of ancient superstition, which, I believe, is recorded by Plutarch. It seems some Persian and Egyptian priests had a contest, which of their deities had the superiority. The Egyptian said, that a single vase, sacred to Serapis, would extinguish the whole power of the Persian deity of fire. The experiment was tried; and the wily Egyptian, boring holes in the vase and stopping them with wax, afterwards filled the vase with water; which, gushing through the holes as the wax melted, extinguished the Persian deity. Hence the vase was deified."

13. The Holy Senate and Holy People, appear frequently on the Greek imperial coins, sometimes represented as old men with beards, at others as youths.

The goddesses represented on medals are:—

1. Juno, represented by a beautiful young woman, sometimes with a diadem, sometimes without any badge, which is reckoned a sufficient distinction, as the other goddesses all wear badges. Sometimes she appears as the goddess of marriage, and is then veiled to the middle, and sometimes to the toes. She is known by the peacock, a bird sacred to her from the fable of Argus.

2. Minerva is very common on the coins of Alexander the Great; and her bust has been mistaken by the celebrated painter, Le Brun, for the hero himself. She is very easily distinguished by the helmet. Her symbols are—her armour, the spear in her right hand, and the ægis, with a Medusa's head in her left; an owl, commonly standing by her.

3. Diana, of Ephesus, is commonly represented on the Greek imperial coins; and appears with a great number of breasts, supposed to denote universal Nature. She is supported by two deer, and carries a pannier of fruit upon her head. The bust of this goddess is known by the crescent on her brow, and sometimes by the bow and quiver at her side.

4. Venus is known by an apple, the prize of beauty, in her hand. Sometimes she is distinguished only by her total want of dress; but is always to be known by her extraordinary beauty, and is sometimes adorned with pearls about the neck.

5. Cupid is sometimes met with on the Syrian coins, and is known by his infancy and wings.

6. Cybele is known by a turretted crown and lion; or is seen in a chariot drawn by lions.

7. Ceres is known by her garland of wheat, and is common on the Sicilian coins; that island being remarkable for its fertility. Sometimes she has two serpents by her, and is sometimes drawn in a chariot by them. She carries in her hands

the torches with which she is fabled to have gone in search of her daughter Proserpine.

8. Proserpine herself is sometimes met with on coins, with the name of κορν, or the *girl*.

9. The Egyptian Isis has a bud or flower on her head; a symbol of the perpetual bloom of the inhabitants of heaven. She carries also a sistrum in her hand.

10. The Sidonian Astarte appears on a globe supported on a chariot with two wheels, and drawn by two horses.

These are the deities most commonly represented on the Greek coins. The more uncommon are—Saturn with his scythe, or with a hook on the Heraclian coins; Vulcan, with his tongs on the reverse of a coin of Thyatira, represented at work in the presence of Minerva. Adranus, a Sicilian god, is sometimes represented on coins with a dog. Anubis, an Egyptian deity, has a dog's head. Atis is known by his Phyrygian bonnet; Castor and Pollux, by a star on the head of each; Dis, by his old face, dishevelled hair and beard, and a hook; Flora, by her crown of flowers; Nemesis, by her wheel; and Pan, by his horns and ears, belonging to some kind of beast.

WEST LONDON MENTAL IMPROVEMENT SOCIETY.

To the Editor of the Penny Mechanic and Chemist.

Sir,—Having been for some time a subscriber to your valuable Journal, I am induced to send you a notice of a new Society very lately formed. If you will oblige us by inserting a notice of our Society and its lectures weekly, you will confer a benefit on us, and on the course of mental improvement in general. On Tuesday, Nov. 15, James Smith, Esq., lecturer at the London Mechanics' Institution, delivered a lecture "On the Means of Acquiring Knowledge." To be followed every Tuesday by other lectures. If any of your talented correspondents would give us a lecture occasionally, we should take it as a great favour. I would not have troubled you, but we know the interest you take in all kinds of mental improvement. Our terms of contribution are, 6*d*. entrance, and 8*d*. a month, payable in advance. Non-members admitted to the lectures at 2*d*. each, and to the Vocal Music Class, 6*d*. a month.

I am, sir, yours, &c.,

E. Wallace, Sec.

MISCELLANEA.

Brass Guns.—Experiments have been tried in the Marshes at Woolwich, with a new description of brass gun, invented by Captain Grant, of the Royal Artillery. From the diameter of the bore being four inches and one-sixteenth of an inch, the gun has been denominated a light nine-pounder. It is so well proportioned, however, that it weighs only 10 cwt. 1 qr. 14 lbs., while the other nine-pounder guns at present in use, 13½ cwt. at least, on the average. This is an advantage of some consideration, and will effect a great saving in metal, valued at 183*l*. per ton. But the most important saving will be attained, when used in exercise and in field warfare, as there is a difference of fully 4 cwt. less in favour of Captain Grant's brass gun and carriage; 3½ cwt. nearly on the gun, one-half cwt. on the carriage and timber, and 34 lbs. less weight of powder, when supplied with forty-eight rounds of shot and ammunition. The firing took place from a range of 1200 yards, and the first shot was fired at an elevation of three and one-eighth degrees, and the recoil was then only seven feet nine inches. None of the remaining shots exceeded in recoil eight feet two inches, and No. 4 only recoiled seven feet two inches, while the whole of the balls, with one exception, reached the target, the other having fallen about 100 yards short, probably owing to the taking of the elevation. The saving of powder by Captain Grant's invention will be considerable, being three-quarters of a pound on each time it is fired, his charge being 2¼ lbs., and the present charge 3 lbs., for guns of the same calibre. It was thought by many, that the invention would be most likely to fail from too great recoil; but Captain Grant has so proportioned the metal, and with such correct judgment, that no fears are now entertained in that respect; and, from the elegance of the model, lightness, and, at the same time, ample strength of the carriage, it is likely to be introduced into the service, and will be far easier of draught for the horses.

Population of Ancient Rome.—Dr. Loudon, of Paris, in his late work on population, asserts that ancient Rome, in her greatest splendour, contained 8,000,000 souls. M. de la Maille, and the modern French academicians generally, will scarcely admit that there ever were more than from 400,000 to 500,000 inhabitants within the walls of the Eternal City. Other antiquaries are equally contradictory. Gibbon and Hume supposed the numbers

to have been 1,000,000. Mr. Jacob, in his history of the precious metals, has calculated them at 1,200,000; so did Brottier, the celebrated commentator on Tacitus. The late Professor Nibby, in his "Roma Antiqua," conjectured that the citizens, strangers, and slaves, with their children, must have reached 2,000,000. Chateaubriand reckons 3,000,000. Justus Linains and Mengotti computed them at 4,000,000. Isaac Vossins allowed the possibility of 8,000,000, perhaps, said he, 14,000,000. There are still more extravagant calculations on this obscure point of archaiology. Rolefinchus and several other writers, have actually declared their belief, that in the time of the early emperors, there were conglomerated on the seven hills and on the banks of the Tiber, around the seven hills, upwards of 27,000,000 of human beings. Amidst this discrepancy of opinion, it is probable that the notion of 8,000,000 of souls in ancient Rome, as maintained by Dr. London, is that which is the most correct; being founded on sixteen different statistical facts drawn from the ancient authors, each leading to the same conclusion. In the year 1377, when Gregory XI. was pontiff, the city of Rome contained no more than 17,000 people! At present, the entire numbers do not exceed 160,000. How mutable are human events! Albion, the Botany Bay of Rome, is now the mistress of the world. The Palatine Hill is partly occupied by an English College, and a large portion of it is owned by an Englishman, Mr. C. Mills.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, November 23, E. N. Dennys, Esq., on Ben Jonson. Friday, November 25, J. M'Pherson, Esq., on The Comparative Progress of Education and Society. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, November 24, S. Preston, Esq., on Education. At half-past eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, November 21, on National Education. At a quarter-past eight o'clock.

QUERIES.

How to make oil-skin cloth? T. P.

How to make aquafortis, that which is used by brass founders for dipping brass work? Also how ormulo is done? A. S.

"J. M. J." is much obliged to "G. Starkey" for his information respecting the Drummond light, and has taken his advice, and made a blowpipe himself. Perhaps "G. Starkey" will favour him with a description of Pepy's gas holder, which he mentions; also the size of the hole through which the gas issues from the blowpipe? Will he be so good as to send me some lime cylinders, if I send him a letter containing the needful?

J. M. J.

Does mercury enter into the composition of wheat when mixed with it previous to sowing? How to temper watch-springs? E. L.

ANSWERS TO QUERIES.

"T. Whitlock." Letters can be gilt on cards by the following process:—First do the letters in lightly with a little gum or parchment size, and afterwards with some mastic varnish, which, when sufficiently set, apply the gold leaf; when dry, rub it off lightly with a small piece of tool. H. G. S.

"C." will find the method of producing the dissolving views fully explained in the last volume of the PENNY MECHANIC.

"Z." Is not the stain in the shawl produced by the vinegar having partly discharged the dye? If so, there is no remedy.

"S. E. s" request has been complied with; a paper on the subject is now in the hands of the Editor.

"W. Whiddon." The resin is possibly dissolved in spirits of wine, strained, and evaporated.

"G. S." can get the notes used in accordions, made by a man of the name of Tully, 30, Belton Street, Long Acre,

"J. Wilkins." My address can be obtained from the Editor, No. 1, Long Lane, Aldersgate.

"J. R." has most likely failed in heating the platinum wire, by using a battery of which the cells are too small; one large cell being more efficacious. I have heated brass wire with a single pair of Smee's, of about forty-eight square inches surface, and the wire was by no means thin. I never find any deposit on the platinized silver, however long it is kept in action; and I have sometimes left it four whole days without any attention whatever. Perhaps the zinc in "J. R.'s" battery is not properly amalgamated, or the sulphuric acid may be too close to the silver, to allow a free current of the exciting liquid, which ought to flow out in a continual stream from between the plates when in action.

G. S., Jun.

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

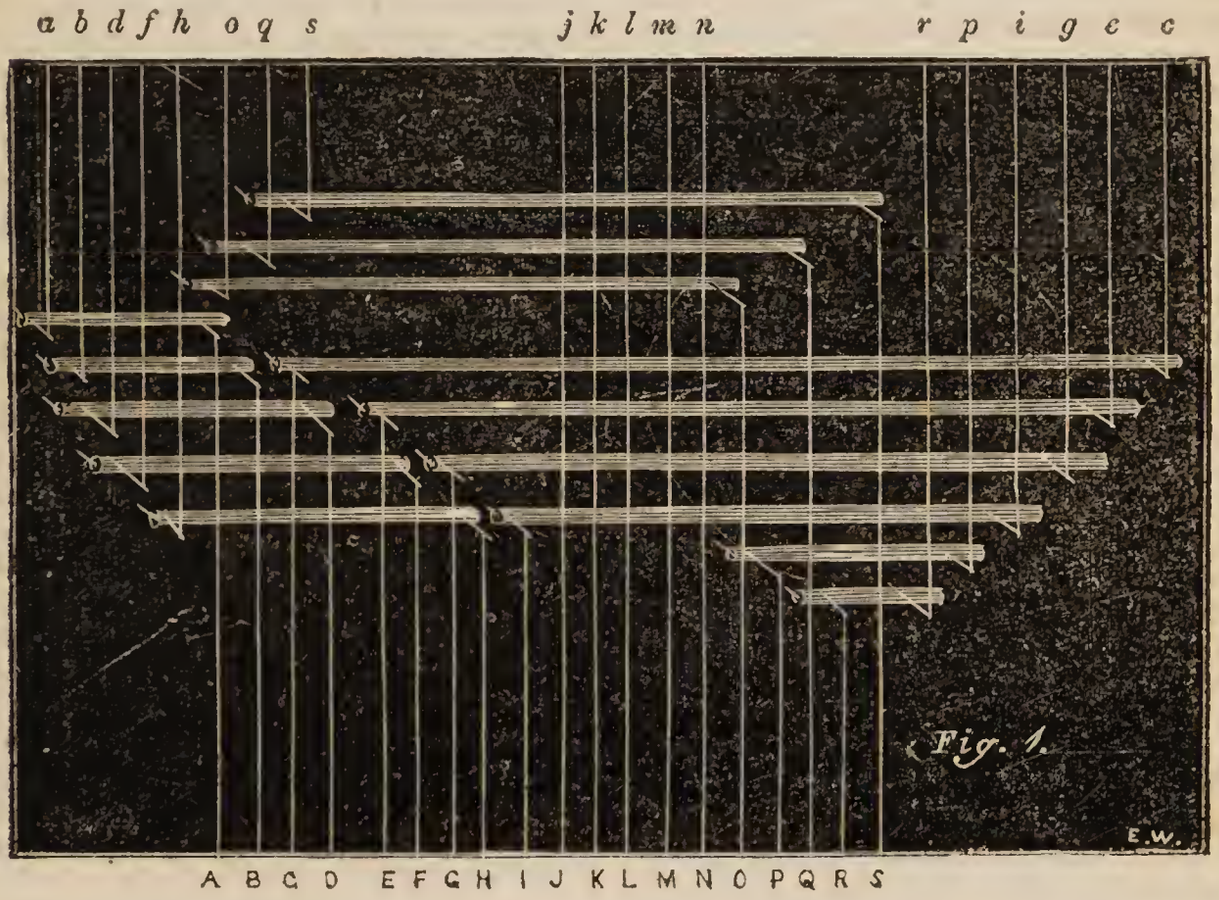
THE PENNY MECHANIC

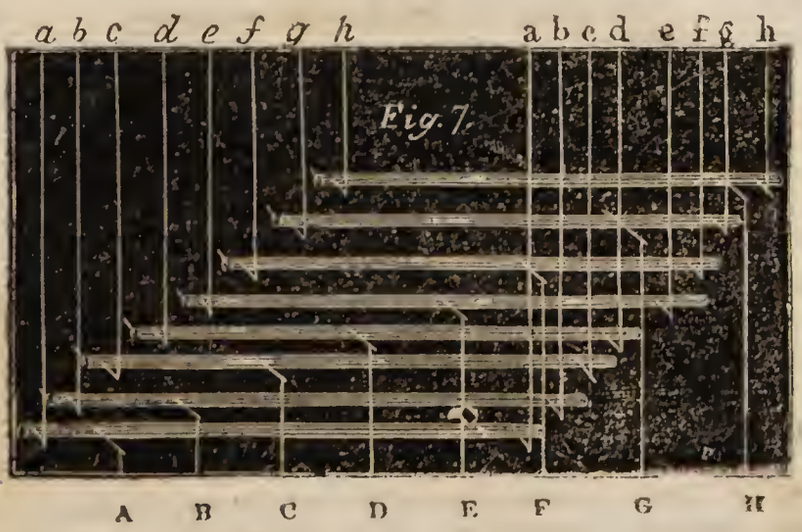
AND CHEMIST.

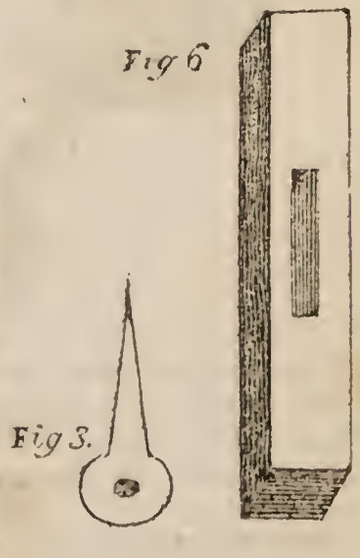
A MAGAZINE OF THE ARTS AND SCIENCES.

No. 111, THIRD SERIES. | SATURDAY, NOV. 26, 1842. | No. 359, OLD SERIES.

MECHANISM OF ORGANS.







Vol. VIII.—No. 52.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney

THE MECHANISM OF ORGANS.

ROLLERS AND TRACKERS, COPULA, STICKERS, &c.

To the Editor of the Penny Mechanic and Chemist.

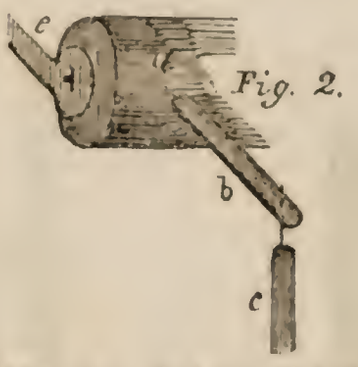
Sir,—In my former papers on the mechanism of organs, I described an arrangement of levers in the form of a fan, for the purpose of distributing the power applied to the keys, to the parts where the pipes could be conveniently placed. At the time I commenced those papers, I only intended to give a general idea of contrivances made use of, in order to effect the different objects required; I, therefore, omitted many particulars which I thought would swell the subject to too great a length; but having been applied to by so many parties for farther information, I have from time to time sent communications on different parts of the same subject, as the various querists have requested, and it has, therefore, caused them to be written without any regard to arrangement. I am now requested to explain the method of making the pedals act on the keys; also of connecting one row of keys with another; but in order to explain the former, it will be necessary to describe another method of distributing the power applied. In the fan-shaped arrangement of levers, it requires a considerable depth from back to front; but in a system of rollers and trackers, as they are termed, that difficulty is obviated, though what it gains in depth, it loses in height.

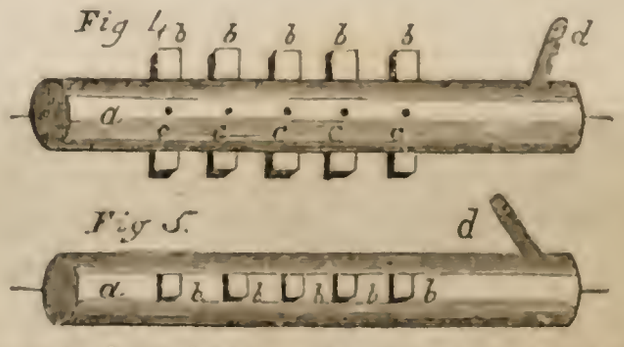
Description of the Engraving.

Fig. 1 is a flat board, placed at the extremity of the keys, farthest from the touch, immediately over, and perpendicular to them. We will assume, that the ends of the keys are immediately under the perpendicular lines (which represent the trackers) at the points marked A B C, &c., in fig. 1. The rollers are slips of wood, cylindrical, or somewhat of that form, having an iron pin at each end, so as to form an axis for them to partly revolve upon. These pins are placed in eyes, like fig. 3, hammered into the upright board at the proper places.

Fig. 2 shows one end of a roller. Each roller has two short levers, about an inch long, made of some thin strong wood, projecting from it at right angles, one of which is seen at *b*, fig. 2; *a* is the roller; *c*, the eye. This short lever, *b*, has a hole nearly at the extremity, to admit a wire at the end of the tracker, *c*; and this wire is furnished with a piece of thick leather, which screws on to it like a nut, either above or under the short lever, *b*, according as the action is required, either to pull down or push up the lever.

Now on examining fig. 1, we shall find that, by touching the first key, it will push up the tracker, A *x*, cause the roller, *x y*, to partly revolve on its axis, and push up the tracker, *y a*. If we touch the third key, it will push up the tracker, C *z*, make the roller, *z w*, perform parts of a revolution, and raise the tracker, *w c*, and so on with the rest; the capital letters showing where the key acts, and the corresponding small letters point out where the action is carried to. Another set of short levers are placed over the board to reverse the action, and by this means the action can be carried to any part of the instrument that it is desired. This is an object of great importance in large organs, as it is desirable to place one pipe on the right, and the next on the left, in order to distribute the weight equally; as, without some arrangement of this kind, all the bass pipes, and, consequently, all the weight, would be on one side.





In organs where there are two or three rows of keys, there are, in fact, two and three organs in one case; each row of keys having its own sound-board, pipes, &c.; so that it becomes desirable to be able to connect the different banks of keys with each other; so that, by playing on one bank, the others may be drawn down at the same time, in order to give the full power that the instrument is capable of producing. The draw-stop that effects this is called a copula.

Between the upper surface of one row of keys, and the under surface of that row above them, at the extremity farthest from the touch, there is a space of about one inch and a half or two inches in height. Within this space is a cylindrical piece of wood, about an inch in diameter, and several inches longer than the rows of keys; it has also a pin at each end for an axis, similar to the rollers; and over each key there is a small square mortice hole cut, of about one-fourth of an inch square; and through these mortice holes are placed little square pieces of wood, called stickers, of a sufficient length to fill the space between the two rows of keys.

Fig. 4, *a* is the cylindrical piece of wood; *b b b b b*, the stickers, of which there must be as many as there are keys, though I have shown only five for convenience; *c c c c c*, pins thrust through the roller and stickers, to retain them in their place. Of course, each sticker has a long mortice, through which the pin is thrust, to allow of its being moved up and down to a certain extent.

Fig. 6 shows a sticker about the natural size.

When the copula action is in the position shown in fig. 4, the lower bank of keys being played on, the bank above is, of course, acted on as well—the farther ends being pushed up by the stickers; and, in order to disconnect them, the cylindrical piece of wood is made to perform a quarter of a revolution, and it will then appear as in fig. 5; the stickers then lying horizontally, leave room for the lower keys to be played upon without acting on the others.

The cylinder is made to revolve by a short lever, *d*, figs. 4 and 5, placed at an angle of 45° with the stickers, and connected with a draw-stop.

Fig. 7 shows a system of trackers and rollers applied to the pedals of an organ, each roller having an action at both ends, so that one of the upper trackers may communicate with the pedal sound-board, and the other with some short reversing levers under the bass keys of the manuals; and, by a similar arrangement to that already explained, the pedals can be connected with them. Other expedients are sometimes resorted to, to effect this last copula--that is, the pedals with the manuals; but that which I have given is the simplest, and all other arrangements are on a similar principle.

There are different mechanical arrangements, almost innumerable, that must be used for different purposes, according to the plan of the instrument; but, after all, the principle remains the same in every one, and it would require several thick volumes to describe the subject of organ building fully.

Should I not have made myself clear to any of my readers, I shall be most happy to give any farther information in my power.

I remain, yours &c.,

G. S., Jun.

CONDITION OF THE WORKING CLASSES.

To the Editor of the Penny Mechanic and Chemist.

Sir,—The present condition of the working classes of this country appears quite paradoxical; for we daily see those people who raise the food, who spin all the yarn, who weave all the cloth, and who produce all the wealth, almost starving for the want of food, and clothed in rags, at the same time that there is abundance of food and clothes in the country. We see machinery introduced into almost every branch of agriculture and manufactures, throwing immense numbers of industrious people out of employment, who are compelled to leave their native land, to seek a livelihood in some more prosperous country, or to ramble about the streets of our towns and villages, idling their time away, producing nothing, and, therefore, having to be kept by those who are producing wealth of one kind or other. Now if the population of this country should keep increasing in the manner it has done, during the last ten years; and if the trade does not increase to a most extraordinary extent—which I do not expect it will do—there must be some measures adopted to find employment for the people who will be unemployed, or this country will be one great poorhouse, and the majority of the people will be paupers.

There is one plan which may be adopted, and which will have a tendency to find employment for all those who are unable to obtain it at present; and that is by cultivating land with the spade to such an extent as the family of the labourer can supply the requisite amount of labour; for we are very sure that, when a man has a large family, some portion of that family will be able to assist him in his daily labour on the land, and, consequently, he will be enabled to cultivate a larger portion than a man who has no family. But whether a man has a family or not, he will want a house to live in, and the

health, and comfort, and happiness of the man, depend very much on what kind of a house it is. It should not be damp, or badly ventilated, or liable to become a harbour for vermin of any kind; for if it be, there will be very poor health, and little comfort for him either by night or day.

I will, by your permission, describe a house, which will be air proof, water-proof, and fire-proof; it can be built at a small expense, will be very convenient, and, if the owner do not like his neighbourhood, or the quality of his land, he may place four wheels under his house, and remove it to a more convenient situation.

This house, I intend, should be twenty-four feet long inside, twelve feet wide, and eight feet high. It should be made of sheet iron, one-eighth of an inch thick; the plates to be riveted together with three-eighth rivets, and the joinings at the angles to be made with one-fourth inch angle iron. It should be divided into two apartments by a partition of the same material as the other part of the house, and the outside walls should be carried up two feet higher than the roof. If the roof be finished in a workman-like manner, the top of the house will form a cistern capable of holding a large quantity of water. There should be four rods of half-inch round iron, placed at equal distances across the house, immediately below the roof; these rods will prevent the walls from bulging outwards, and should have nuts at each end to screw them up tight.

The house should be painted inside and outside with cream-coloured paint; as it will reflect the rays of the sun to a considerable extent in the summer, and, therefore, will keep the house cooler than if the colour were darker; it will also prevent the radiation of heat in the winter, and will keep the house warmer, for the same reason.

It should be heated by a fire place, having an oven on one side, and a boiler on the other. The boiler should extend as high as the top of the oven, and over the fire at that height, it should have a close top, and be supplied with water from the cistern by a ball-cock. There should be a cock at the bottom for drawing hot water when required, and two pipes should pass from the top, and the other from the bottom of the boiler, through the partition, and half round the bedroom, where they should join. There should be two cocks attached to these pipes near the partition, which would prevent the water from passing through in hot weather. These pipes, when open to the boiler, would allow a constant circulation of hot water to pass through them; as the hottest portion in the boiler would pass through the top pipe, and, after it had parted with a portion of its heat in the room, it would return, by the bottom pipe, into the bottom of the boiler. Thus the room might be heated to a comfortable temperature without an extra fire-place, and with the same fire that is constantly used in the kitchen.

There should be a slop-stone placed between the fire-place and the wall, with a pipe and cock from the cistern, and also a pipe to carry all the dirty water away into a reservoir, where it should be preserved as liquid manure for the garden. The chimney should pass through a water-tight cylinder in the roof, to prevent the water from the cistern coming down its sides; and should be made of iron, the same as the other part of the house. There might be a large cupboard, with drawers underneath, placed on each side of the door, as it would be the coolest part of the house; and where the food was kept, it might be ventilated by having quarter-inch holes drilled in the outside walls and shelves; so that a current of cold air would constantly pass through the cupboard, out at the top, through the kitchen, and up the chimney; thus ventilating the house at the same time in one of the best possible manners.

If you think this paper worthy of a place in your valuable Magazine, I will continue the subject next week, by giving you the probable weight and cost of the house; and, also, what a man may do with an acre of land attached to it.

I am yours, &c.,

C. W. Tonge.

MANUFACTURE OF GUN-BARRELS.

(Continued from page 395.)

The next operation in forming the barrels, is the boring of them, which is done in the following manner:—Two beams of oak, each about six inches in diameter, and six or seven feet long, are placed horizontally and parallel to one another, having each of their extremities morticed upon a strong upright piece, three feet high, and firmly fixed. A space of three or four inches is left between the horizontal pieces, in which a piece of wood is made to slide, by having at either end a tenon let into a groove, which runs on the inside of each beam throughout its whole length. Through this sliding piece, a

strong pin or bolt of iron is driven, or screwed in a perpendicular direction, having at its upper end a round hole large enough to admit of the barrel, which is secured in it by means of a piece of iron that serves as a wedge, and a vertical screw passing through the upper part of the hole. A chain is fastened to a staple in one side of the sliding piece, which runs between the two horizontal beams, and, passing over a pulley at one end of the machine, has a weight hooked on it. An upright piece of timber is fixed upon this pulley and between the ends of the beams, having its upper end perforated by the axis of an iron crank, furnished with a square socket; the other axis being supported by the wall or by a strong post, and loaded with a heavy wheel of cast iron, to give it force. The axes of this crank are in a line with the hole in the bolt already mentioned. The borer being then fixed into the socket of the crank, has its other end, previously well oiled, introduced into the barrel, whose breech part is made fast in the hole of the bolt. The chain is then carried over the pulley, and the weight hooked on; the crank being then turned with the hand, the barrel advances as the borer cuts its way, till it has passed through the whole length. The borer consists of an iron rod, somewhat longer than the barrel, one end of which fits the socket of the crank. The other is adapted to a cylindrical piece of tempered steel, about an inch and a half in length, having its surface cut after the manner of a perpetual screw, with five or six threads, the obliquity of which is very small. The breadth of the furrows is the same with that of the threads, and their depth sufficient to let the metal cut by the threads, pass through them easily. Thus the bit gets a very strong hold of the metal, and the threads, being sharp at the edges, scoop out and remove all the inequalities and roughness from the inside of the barrel, and render the cavity smooth and equal throughout. A number of bits, each a little larger than the former, are afterwards successively passed through the barrel in the same way, until the bore has acquired the magnitude intended. By this operation, the barrel is very much heated, especially the first time the borer is passed through it; by which means it is apt to warp. To prevent this, in some measure, the barrel is covered with a cloth kept constantly wetted, which not only preserves the barrel from an excess of heat, but likewise preserves the temper of the bit being destroyed. The borer itself must also be withdrawn from time to time, both to clean it from the shavings of the metal, and to oil it or repair any damages it may have sustained. Every time a fresh bit has been passed through the barrel, the latter must be carefully examined, to see if it has warped, and likewise if there are any spots—by the workmen called blacks—on its inside. When warped, it must be straightened on the anvil, for which a few slight strokes on the convex part will be sufficient, and this is termed setting up the barrel. When black spots are perceived, the corresponding part on the outside must be worked and driven in by gentle strokes with the hammer, when they will be completely removed, by passing the borer another time through the piece.

The equality of the bore is of the utmost consequence to the perfection of a barrel; insomuch, that the greatest possible accuracy in every other respect, will not make amends for any deficiency in this. The method used by gunsmiths to ascertain this, is by a cylindrical plug of tempered steel highly polished, about an inch in length, and fitting the bore exactly. This is screwed upon the end of an iron rod, and introduced into the cavity of the barrel, where it is moved backwards and forwards, and the places where it passes with difficulty being marked, the boring bit is repeatedly passed, until it moves with equal ease through every part. Any person who wishes to know the merit of his piece in this respect, may do it with tolerable accuracy, by means of a plug of lead cast on a rod of iron, or even by a musket ball filed exactly to the bore, and pushed through the barrel by a ramrod; taking care, however, not to use much force, lest the ball be flattened, and its passage thus rendered difficult.

The last step towards the perfection of the inside of the barrel, is termed fine boring, by which is meant the smoothing it in such a manner, as to remove all marks and inequalities left by the borer. The fine borer resembles the other in its general construction; but instead of the piece of steel cut in the form of a screw, which belongs to that, it is furnished with a square breech, ten or twelve inches long, highly polished, and very sharp, by which means it cuts the metal very smoothly. It is found to answer the purpose best, when only two of its edges are allowed to work; the other two are covered with slips of oiled paper, one or more additional slips being put on each time that the instrument is passed through the barrel. The fine borer is frequently passed through from the muzzle, until the whole inside presents a per-

fectly equal and polished surface; the barrel being likewise examined and set up, if requisite, after each time. It is absolutely necessary that this instrument should be perfectly true, and not in the least cast or warped in the tempering.

Besides the operation above described, another, called polishing, is usually performed on gun-barrels, though it is doubtful whether this last be attended with any good effect or not. It is performed by a cylinder of at least five or six inches long, cast upon a rod of iron, and filed exactly to the bore. The lead being then covered with very fine emery and oil, is wrought backwards and forwards through the whole length of the barrel, until the inside has acquired the requisite degree of polish. The disadvantages of this operation are—that it is scarcely possible to perform it, without pressing more upon one part than another, and thus producing some degree of inequality on the inside, which is of the very worst consequence to fire-arms. The polish thus given is, likewise, very perishable; so that the fine boring may justly be considered as the last operation necessary for the inside of a barrel; and it is then proper to give the external form and proportions by means of a file. For this purpose, four faces are first formed upon it, then eight, then sixteen, and so on, until it be quite round, excepting the part next the breech, called the reinforced part, which is always left of an octagonal form; it being absolutely necessary that the barrel should be equally thick on every side. Gunsmiths employ, for accomplishing this purpose, a particular tool, named a compass. This consists of an iron rod, bent in such a manner as to form two parallel branches, about an inch distant from each other. One of these branches is introduced into the barrel, and kept closely applied to the side by means of one or more springs with which it is furnished; the other descends parallel to this on the outside, and has several screws through it, with their points directed to the barrel; by screwing these until their points touch the surface of the barrel, and then turning the instrument round within the bore, we perceive, when the metal is too thick; and how it must be reduced, in order to render every part perfectly equal throughout its circumference. It may be made long enough to reach the whole length of the barrel, though it will be more convenient to have it only half as much, and to introduce it first at one end, and then at the other. Instead of rounding the barrel by means of a file or compass, however, some people do so by turning it in a lathe, which is, no doubt, more expeditious, though not so certain nor exact. A spindle as long as a gun-barrel cannot, without great difficulty, be prevented from springing considerably under the tool employed to reduce or smooth it in turning; whence it is found that, by this operation, barrels are more frequently warped than by all the borings they undergo; and there is now this farther inconvenience, that they cannot be set up as formerly, without danger of destroying them entirely.

The barrels being thus bored and formed externally, it is customary with the gunsmiths in France to solder on the hoops and rim before they breech the barrel. The English, however, do not restrict themselves in this manner; for, as soft solder is sufficient for fastening on these, they never use any other; while the French, who use hard solder, must, of consequence, employ a great heat. Thus the inside is roughened, sometimes, so considerably, that it is necessary to repeat the fine boring, which could not be done without injuring the threads of the screw formed for the breech, if the barrel were prepared for the latter, without soldering on the former.

NEWLY-INVENTED BOOTS.

To the Editor of the Penny Mechanic and Chemist.

Sir,—There have been no less than half-a-dozen different descriptions of boots invented, five of which have been patented, within the last two years, and, I am told, two others are in process of being patented at this time. What would our square-toed forefathers say, could they but rise in these times, and see a splendid boot, made by "Hoby," the invention of a Mr. Wilkins, of Hull, which, for the use of your readers I will, as far as I am able, describe? The boots are handsome and more durable than any other sort. They are as easy to the feet, when walking on the roughest road, as any others are on the softest carpet. The lightest boots on this principle are perfectly waterproof to the last. They are noiseless and creakless, and are called the "accelleropœdo." For people with tender feet and for waltzing, they are invaluable; and, I believe, that a person may walk twenty miles with these boots with more ease than he could walk twelve miles in any others; as they are filled throughout between the soles with metal springs, and a chemical article

is spread all over the insole, which gives them a delightful feel to the wearer.

I remain, yours &c.,

A FOREIGNER.

MISCELLANEA.

Bell Rock Lighthouse.—During the late heavy gales which have done so much damage to shipping, particularly between the 19th and 23rd ult., the sea sprays appear, by the monthly returns from the Bell Rock Lighthouse, to have risen upon the building to the height of from sixty to ninety feet every tide. While this heavy sea, one of those great detached masses of stone, familiar to the lightkeepers by the name of "Travellers," was forced across the rugged surface of the rock, about 100 yards to the lighthouse, where it destroyed part of the cast-iron landing-wharf. This stone measures about seven feet in length, three feet and a half in breadth, two feet and a half in thickness, and must have weighed about four tons. To prevent mischief by the movement of these great stones, the lightkeepers are provided with quarry tools, with which they broke it up and arrested its progress, but it was no easy task, from the run of the sea. The heaviest seas which visit the Bell Rock, are from the north-east, but the present gale was chiefly from the north-west; and it is not a little remarkable, that the Frith of Forth was but little affected during this storm, above the Island of May.

Floating Breakwater.—Captain Groves, late of the Rifle Corps, has arrived here for the purpose of trying an experiment of a cylinder, with some iron pendants, as a floating breakwater in the bay. At this early stage of the proceeding, we are quite unable to form any opinion as to the probable success of the measure. The cylinder or caisson is formed of iron, steamboat boiler shape, fifty feet long by six feet in diameter. It is divided into compartments, so that though a hole were by chance made in it, it would not sink. It was made at Birmingham, under the superintendence of Captain Groves, the inventor, and brought here by a government steamer, under the auspices of the Admiralty. From the cylinder vertically is carried down an iron grating eight feet long; and as the cylinder, when so loaded, will float, at half its diameter, this will make eleven feet immersed in the water. The object of the present experiment is not, we understand, to test the powers of such a breakwater, but to prove that very powerful anchors and chains have been furnished by the Admiralty. Were we to judge from the ponderous anchors (about two and a half tons each) to which the cylinder is to be moored, with equally ponderous chains capable of holding a frigate in holding ground, we should suppose that hardly any power in nature would be able to bring it home.—*Dover Chronicle.*

Machine for Making Bricks and Tiles.—A very ingenious machine, constructed by Mr. Ainslie, is now on view at the pin-manufactory in the Borough Road. A very short description of the objects and operation of this invention will show its value to manufacturers of tiles or bricks, and more especially to those persons who are engaged in draining land. The clay is thrown in on the top of two circular cylinders, which are placed perpendicularly at a distance of about a quarter of an inch from each other, and the clay is thus ground between them and falls into a receiver below, crushing to atoms all stones and other impurities, so that even bad material can be used. The clay is then propelled forward against the iron plate on which are cut the apertures through which the tiles, bricks, &c., to be manufactured, are forced. The material moves forward on a sheet of felt, and wire cuts each tile or brick as it moves forward into equal lengths. The clay comes through the iron plate in three supplies at once, and it is calculated that on an average thirty tiles of the most perfect form are made in one minute under ordinary circumstances, but much more may be done; bricks about the same as flat tiles double the number. The great advantages in this process are, that the articles made come from the machine in perfect form and ready for drying in the kiln; and, being thus perfected by machinery, the backs of the curved drainage tiles are stronger than those made by any other process. Here the substance must be of one thickness, and the shape uniform and smooth in all respects. The cost of making 3000 drain tiles a-day by hand, is calculated at £1 0s. 6d. or of 1000 at 6s. 10d. The cost of manufacturing 10,000 of the same article in a day by the machine is 14s. 6d.

The "Telemaque" Treasure Ship.—During the early stages of the great French revolution, the *Telemaque*, containing a vast quantity of treasure, was wrecked and went down off Quillebœuff. Various attempts have been made to raise her, but hitherto without success. Some English engineers have now, however, undertaken the enterprise, and there is

every probability of her being raised. *Galignani* says:—"The works for raising the *Telemaque* from the ground, where she has so long lain, off Quillebœuf, are going on slowly, but surely. Her hull is within three feet of the surface at low water, and is kept steady in that position. As the river at this spot is only about twenty-nine feet deep, and the vessel measures in her own depth twenty-one feet six inches, she must have been raised already above four feet from the bottom. A man has walked on her side as she lays, from one end of her to the other, having the water no higher than his waist. All the tackle holds strong and steady. At the date of the last accounts, Mr. Taylor was engaged in arranging the apparatus, so as to act with greater force, and is said to have declared that in four days the *Telemaque* would be above water."

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, November 30, E. N. Dennys, Esq., on Shakspeare. Friday, December 7, Quarterly Meeting. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, December 1, J. Wonfor, Esq., on Fermentation, and the Arts of Brewing and Distilling. At half-past eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, November 28, Mr. J. Thorne, on the Application of Geology to Mining. At a quarter-past eight o'clock.

QUERIES.

I shall be very much obliged if you or any of your numerous correspondents can give me the titles, or refer me to any work or works containing the most useful recipes of a practical kind in the arts and sciences. I am often in want of information, such as a work of that kind would supply; but I do not know what would be the best to get. I shall esteem it a favour if the prices and publishers' names could also be given. H. BEECROFT.

The manner in which the main-springs of watches are made? J. W. J.

Can any of your correspondents describe a clock-maker's engine for cutting the teeth in wheels? How to make a geometric chuck? How to cut a hexagon, sexagon, nonagon, &c., and how to engrave a medallion, in a lathe? E. L.

Having been requested by a friend in the West Indies to procure him some columns and pilasters for the adornment of a house he is building; and he having referred me to the following works for the patterns—viz. "Nicholson's Architecture," and Pugin's edition of "Normand's Parallel," I shall feel greatly obliged if any of your correspondents can inform me where I can get a sight of them. Also, any information as to which is the best and cheapest material for having them made of—viz. cast iron or other metal, stone or slate, and which would be the lightest.

G. S., Jun.

ANSWERS TO QUERIES.

To Brown Gun Barrels.—After the barrel is filed to the proper size, it should be polished with fine emery and oil, till it presents, in whatever way we observe it, a perfectly smooth and even surface. When this is done, rub it over with aquafortis or spirit of salt, diluted in water; lay it by for a week, till it is covered with a complete coat of oil. A little oil is then to be applied, and, after rubbing the surface dry, polish it with a hard brush and bees' wax. In order to make a common barrel look like a twisted barrel, a piece of string should be wound round the barrel in a spiral form, and wetted with the diluted aquafortis or spirit of salt, so that a complete coat of rust is formed where the string touches. When the acid is applied over the whole barrel, the part where the string was applied, by being more rusted than the rest, shows a dark line, winding in a spiral direction, round the barrel, and renders it when finished, undistinguishable from a twisted or ribbon barrel. Others are, in like manner, clouded in an irregular way, so as to resemble those formed of stub iron. J. W. J.

"A. L. S." Meal or mealed-powder, is only gunpowder reduced to an extremely minute and impalpable powder in a mortar.

"T. Whitelock" can gild letters on card by means of what is called "gold shell;" it can be procured for about a shilling a shell at any fancy stationer's, and is laid on with a camel-hair pencil, like any water-colour.

G. S., Jun.

"J. W." may crystallize glass windows with a hot solution of Epsom salts, or still better with sal ammoniac. Wet the glass with this solution, and lay it on equally with a soft brush; the moisture will almost instantly be evaporated, and the salt will be deposited on the glass in a beautiful radiated form.

E. LEDGER.

"A. S." may procure the circular steel plates, similar to those used for circular saws, at any of the tool-shops where Sheffield goods are sold. J. T.

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid; published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 112, THIRD SERIES. | SATURDAY, DEC. 3, 1842. | No. 360, OLD SERIES.

RAPSON'S IMPROVED DRAG FOR CARRIAGES.

FIG. 2.

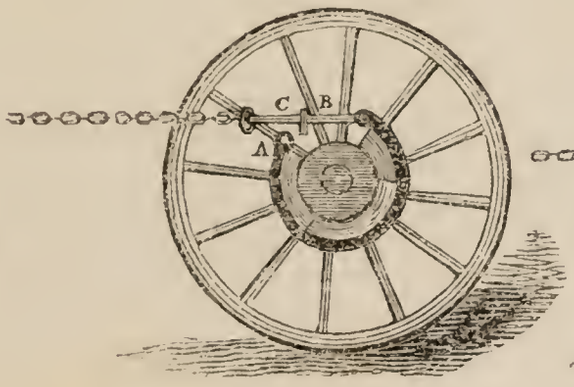


FIG. 3,

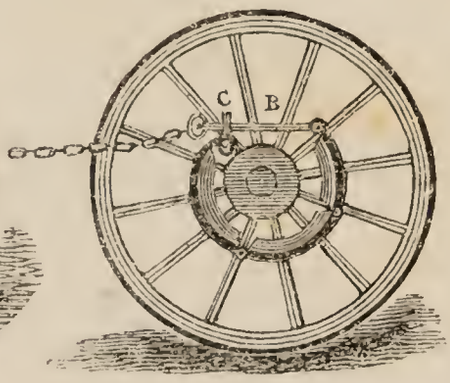
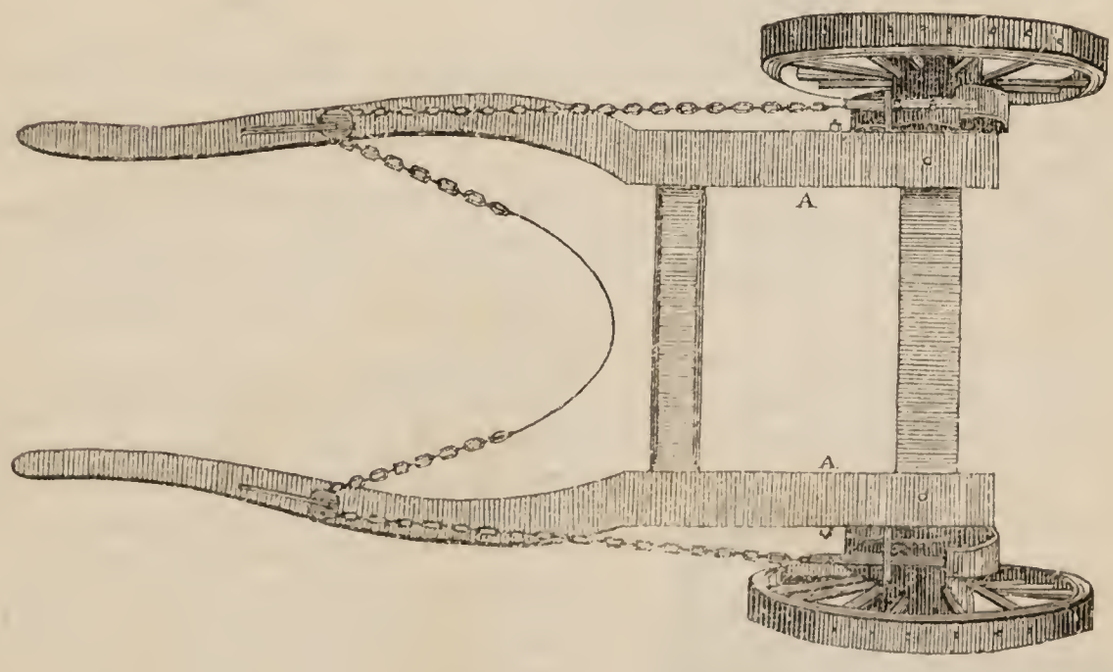


FIG. 4.



Vol. VIII.—No. 53.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

IMPROVED DRAG FOR CARRIAGES.

(See Engraving, front page.)

This drag is to be applied to the naves of the carriage wheels, with a chain attached, fastened to the breeching of the horse, and a small pin on each side of the shaft is to go into the hole of the bar of the drag. If one of the pins be taken out, one wheel will be dragged and the other not. By leaving out both pins, the two wheels are dragged in going down hill, by the breeching bearing against the horse. The wheels will revolve round on a level road, and, in going up hill, undrag themselves. When the wheels are braced, two or three tons weight have very little pressure on the horse in going down hill.

If two loaded carts should meet on a narrow hill, by unhooking the drag-chain from the breeching, and hooking it to the tub-chain, the horse can be put back with the greatest ease and safety. When the horse is put back against the hill, the two pins must be put in the bars of the drags.

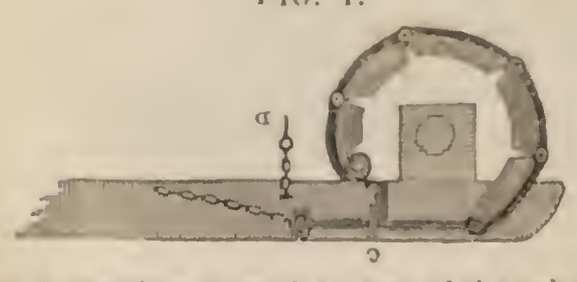
The drag consists of a wooden brake, applied round the nave of each wheel, in pieces which are encircled and connected by a jointed iron plate. The small bar attached to one end of this brake, slides freely through a corresponding hole in a plate, fixed at right angles to the shaft; a hole is drilled through this sliding bar, for the purpose of admitting a pin or forelock chained to the shaft.

To each end of the breeching is attached a chain, which, passing through a horizontal sheave or pulley on the upper surface of each shaft, is ultimately fixed to the bar of the drag; while the bolts or forelocks remain in the holes behind the perforated plate before mentioned, it is evident the brake cannot tighten upon or drag the wheel; but, on either of those pins being removed, the wheels become immoveable.

Description of the Engravings.

Fig. 1 shows the brake united on the outside by a strong-jointed iron hoop; the

Fig. 1.



wood pressing upon the nave of the wheel. The first, a fixed pivot, A, from the hoop, is fixed to the under side of the frame of the cart; from the other extremity of the hoop of the brake proceeds a bar, B, which slides through the plate or socket, C, fixed to the side of the cart frame; a vertical perforation is made through the bar, B, just behind the plate, to receive the pin, D, which is likewise chained to the shaft; this pin, so placed, prevents any force applied to the chain from tightening the brake on the nave of the wheel.

Fig. 2 represents the interior of a wheel on level ground, the nave surrounded by the brake, which, by its own gravity, is hanging loose, leaving the wheel perfectly free.

Fig. 3 shows a wheel on a declivity, the chain drawn tight by the pressure of the breeching on the horse; the brake, of course, closely surrounding the nave, and forming an effectual drag.

Fig. 4 is a bird's-eye view of the whole apparatus, exhibiting the framing of the cart, the shafts, wheels, and brakes; the chains also are shown, passing from the bars on each side, each round a horizontal pulley on the shaft, and attached to the ends of the breeching. Thus it is evident, that when a cart, furnished with this drag, is going down hill, the load, pressing the breeching against the horse, draws the brake tight by means of the chain, and produces a friction on the nave proportioned, in some measure, to the declivity.

When backing upon level ground, by inserting the pin, D, fig. 1, through the bars of the brakes, the wheels will be kept free.

ON THE FORMATION OF CLOUDS.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I beg to offer a few remarks on the formation of clouds, suggested by what I have seen going on in the regions of the atmosphere, during a residence among the Alps.

Although the time is now remote when clouds were considered by some as bodies having a certain degree of consistency, floating along with the breeze, like froth on the surface of water, the process by which clouds are formed and dissipated, may still be an interesting subject of inquiry.

If we observe any particular portion of the sky on rather a windy day, we are sometimes struck with the sudden appearance of a very small cloud in a part which, a few moments previous, was perfectly clear; and, if we look in the same direction a minute or two after, the cloud will, perhaps, have disappeared, and another

one have been formed at a short distance behind the former. This circumstance would alone suffice to show the great mutability of condition which characterizes aqueous vapour contained in the atmosphere; but, from the great distance at which we generally view such phenomena, and from the consequently minute scale on which they appear to take place, the effects are not very striking, and excite no surprise.

On the summit of the Rigi, the observer is situated in the very zone of atmosphere, in which clouds are, perhaps, most abundantly generated and dispersed; and these changes appear there to go on with the most extraordinary rapidity. Clouds, of apparent insignificance, are, at times, seen to approach the mountain; in a few minutes they will increase wonderfully in size, and frequently envelop the whole summit in an impenetrable mist. During these operations, the form of the cloud will vary incessantly, not only from the effects of the wind, but also from the quantity of vapour alternately absorbed and regenerated in the atmosphere. I have observed small wisps of vapour appear, spread, and be again dissipated, in the course of a few seconds. Indeed everything in these regions announces that vapour, in its visible or vesicular form, is dependant on its temporary state of equilibrium with the air. The rapidity of flight, and the transitory nature of the vapour, are here as striking as are the slow and majestic evolutions of the fleecy summer cloud, when seen from the valley.

The influence of mountains over the vapour of the atmosphere, is sometimes very striking, and adds great interest to the study of the various effects of the clouds in mountainous regions. On one occasion I observed a long line of clouds, driven by the wind from one mountain towards the summit of another, break off as it crossed the space between, and reform at the angle of the opposite mountain, thus leaving an interval in the line of clouds. It was interesting to observe the cloud thus reappear near the summit of the mountain, as if some hidden means for the generation of vapour existed amongst its rocks and chasms. The progressive motion of the cloud along the mountain, recommenced immediately as it formed, and yet its extremities appeared neither to advance nor to recede from the point where its reformation took place, remaining constantly the same. On another occasion, a seemingly contrary effect was observable; a cloud, which followed the ridge of a mountain, hanging, as it were, amongst the firs, was dissipated on reaching a point where the mountain became lower; and, though the cloud continued to advance, it was dissolved with a corresponding rapidity, and thus advanced no farther than this particular part of the mountain.

It would appear, from the above cases, that the influence of the mountains is not only sufficient to retain the clouds in their vicinity, but even to determine, to a certain degree, their spontaneous formation. This direct influence might appear scarcely admissible, unless combined with other causes, of which, however, many prevail in mountainous regions which do not exist in level countries. Whatever its nature may be, its active influence can scarcely be doubted, when the many cases in which vapour, in its visible state, is generated and accumulated in the vicinity of mountains, are considered. Perhaps this influence, however remarkable, does not stand quite alone in the operations of nature. If less familiar to us, we might experience some surprise at the quantity of water distilled, as it were, by trees and vegetables during a fog. If the moisture of the air were in this case precipitated by a process depending on the condition of the atmosphere alone, and had no connexion with a reciprocal state of affinity between the pointed extremities or edges of objects and the particles of floating vapour, all objects exposed to the air would become moistened in exactly the same degree; but a flat road is often seen comparatively dry, while the neighbouring trees are dripping with water.

I introduce this last case as an illustration of the change of condition assumed by atmospheric vapour, as its particles come under the influence of attraction of adjacent bodies. Here it is molecular attraction only: in the cases before alluded to, its attraction may be supposed to exist at much greater distances.

I remain, yours, &c.,

H. T.

Twickenham, Nov. 22, 1842.

LIGHTNING CONDUCTORS FOR SHIPS.

As this subject appears now to involve a question of very considerable importance to the country, and demands the attention of all scientific men, we make no apology for inserting the following substance of a lecture delivered at Portsmouth, by Lieut. Sabben, R.N., in opposition to the principle of W. Snow Harris, Esq., F.R.S.,

for protecting ships from the effects of lightning. It is worthy the attention of our scientific readers :—

The first observation of the lecturer, who, it must be understood, is an unswerving supporter of the old principle of conducting the matter of lightning directly from the truck of a ship, over her side into the sea, and, by means of the strong, flexible, and continuous wire-rope now manufactured, and not breakable but by heavy strain or purposed violence, was an allusion to the word *unscientific*, applied in his posting-bills, giving notice of the lecture, to the opposite system of W. S. Harris, Esq., F. R. S., whose mode of disposing of the same, consists of a bewildering right-angled zigzag process, introducing that very destructive element into a ship, by conductors made of strips of copper, inlaid the whole length of her masts down to her very kelson, and then, by a still more confused and unintelligible process, discharging the same through her frame-work. He said, so firmly convinced was he of the erroneousness of Mr. Harris's arrangement, that he had purposely annexed that harsh term to it, as the means of giving full expression to his own dissent, and also of drawing that public attention to a subject which, all must acknowledge, deeply affected the maritime interests of the country. The plan, he continued, viewed in whatever light, appeared to him so deserving of rejection, that it was impossible for him not to feel humiliation, that necessity existed for the task he had undertaken of exposing its many inconsistencies, and its many glaring unscientific mistakes. After a few other preliminary remarks, but all of importance—the exposition of these errors took place, the lecturer, as he went along, pointing out the singleness of the electric spark when a battery or Leyden jar was discharged—that, too, of a flash of lightning; and, in connexion with these distinct cases, the singleness of their resulting effect, each evidently owing its distinctness to the electricity then in motion, invariably preserving a collected form. This fact, it was maintained, received strong confirmation from the many instances Mr. S. Harris had himself published, of damage done by the matter of lightning to ships, when escaping from those it had entered. And, in connection with these recorded accounts, it was acutely argued, as the disruptions in the vessel's frame-work so injured, invariably took place near the surface of the sea, on which, on all sides it was admitted, discharging atmospherical electricity, sought to distribute itself, that there was, in consequence, strong presumption for saying, that all Mr. H.'s very laboured, very complicated, and very expensive arrangement, below that level for disposing of such intruding electric matter, was altogether superfluous. Nor should it remain unremarked, that here a benign Providence seemed to take the matter out of Mr. Harris's hands, and to be ever ready to defeat the rash and irrational proceedings of conducting lightning into a ship, when, by a more ready, direct, and scientific process, it is possible to divert it from her. The true conditions and formation of the electric circle were long dwelt upon, the lecturer being evidently anxious that all should understand that electricity, when running the circuit, employed only one set of conductors, even though thousands of others were in the vicinity of that one set: that, on the selection being made, the rest remained perfectly unaffected, wholly uninfluenced by it. This he satisfactorily proved by reference to Mr. Harris's own experiments, as well as to others, and strenuously maintained, from these conditions being unquestionably true, that it inevitably followed that Mr. H.'s idea of conveying electric matter out of a ship simultaneously by many bolts in her side or bottom, was an untenable assumption; and which, before being made, required from him the proof that he could form, not only one, but many different electric circles, during one discharge of the Leyden battery. It was particularly impressed, also, that the success of Mr. H.'s first experiment with the *Orestes*, in Portsmouth Harbour, the second being a failure in one of its particulars, was by no means affirmative of the efficiency of his conductors; the use of which would have been entirely and most advantageously superseded, and rendered altogether useless, had there been a small wire, or wire-rope conductor hanging loosely from her mast-head over her larboard or inshore side into the sea. Likewise that, from the success of the first experiment, it was remarked, how manifest it was rendered, that all things in connexion therewith were under the immediate ordering and control of the experimentor; not so, however, in the natural event, which was ever governed by local attractions and peculiar circumstances, which we had no power to adjust or regulate as we please; and which, in its limits, extended no farther than from the surcharged cloud to the surface of the sea or earth. Before concluding his comments on this experiment, the lecturer said, that it must never be overlooked,

that no such thing occurred in connexion with it, neither would it happen in the natural phenomenon, as a general distribution of the electricity then in motion, as Mr. H.'s assumption would lead us to expect, over the metal bolts of a ship and copper sheathing, otherwise the experiment could not have been completed; its full success depending on the fact of its running unerringly, and in a collected form, the exact course designed for it by Mr. Harris. An important observation was made by the lecturer, respecting the nature of the electric spark and of lightning, which we unwillingly omit in our haste to notice that, under the head of attraction of conductors, he was bent on showing that, although Mr. H. had denied the existence of such influence, all in reality he had done to disprove it was, the substitution of the term, "an easy line of discharge" for the word "attraction," leaving all things else precisely in the same state as before. A diagram, copied from Mr. H.'s published papers, was next exhibited, and one of his foot-notes read; both for the purpose of evincing that that gentleman fully admitted the uniform diffusion of electricity over the entire surface of conductors; and yet, unaccountable to explain, as the lecturer strikingly observed, he had, nevertheless, in the very face of the fact he had taken pains to illustrate, and the reasoning deducible therefrom, inlaid his own in the masts and attached them to beams, like one determined that their entire surface should not come into use. This, the lecturer said, would be, however, the absolute fact, whenever his conductors were really brought into action, and had to transmit, not the trifling accumulation of a Leyden battery, but a large collected volume of atmospheric electric matter, descending in all its fury, fully employing and occupying his conductors; and, furthermore, as it was demonstrable by galvanic experiments, that not only, as Mr. H. had himself particularly shown, did electricity equally distribute itself over a conductor, but that, as it moved along it, it assumed a revolving motion, as a waterspout is seen to do round its axis, it, therefore, became manifest, both facts and their collected effects duly considered, that not only were loose hanging conductors, on the principle the lecturer was advocating, requisite for the safe discharge of the matter of lightning, but that, if not free, mischief and destruction must be expected to fall on the material in connexion. All this being certain, from the foregoing reasons, it follows that masts, fitted according to Mr. H.'s plan, are thereby exposed to imminent danger—inlaid conductors along their entire line possessing not the requisite space on all sides around them, for such general superficial diffusion and revolving motion, as have been described to attend passing accumulations of electric matter, when transmitted by prepared conductors. At this place the lecturer most solemnly descanted—keeping the previous observations steadily in view—on the fatal effects that might be expected to happen to a ship protected on Mr. Harris's plan, when a large volume of the matter of lightning, intentionally and daringly brought into her by its means, had to be discharged from her by the employment and occupation of one selected bolt, situated either in her side or bottom. In such a case—and pains had been taken, when explaining the conditions of the formation of the electric circle, to show that such especial selection would be the consequence—actual distribution of such electric matter not taking place until it had reached the surface of the ocean, he said, there was plainly every reason to conclude, that the wood-work compactly surrounding a bolt so chosen, would be splintered off it with violence, while room was making around it for the free passage of the substance of electricity; and, on this happening, the ship would thereby become exposed to imminent danger. An actual fact of this character—the especial selection of one bolt by passing atmospherical electricity, and when many others were in its vicinity, and the destruction of the wood work around it, was noticed; and the lecturer expressed himself confident that, in all the cases afforded by Mr. H., of disruptions made in vessels' sides by escaping electric matter, could these cases undergo re examination, it would be discovered, that the frightful chasms then effected, resulted solely from the mode of operation he (the lecturer) was then expounding. Two more of his many other forcibly-explained and well-applied objections, and the report ends. The first is of that remarkably striking character, as should not fail to attract the general attention it unquestionably deserves—namely, that in most cases recorded, ships, when struck by lightning, have suffered only in the upper or loftier portions of their masts, and that, from thence, the electric matter has passed harmless into the sea, and without penetrating their hulls: a happy, most happy escape of the destructive element, which, however, Mr. H.'s plan presumptuously interferes with; for, instead of assisting this natural averting process, he most de-

liberately and intentionally facilitates and encourages the admission of the unsparing agent into their very heart, vainly building his powers of getting rid of it upon his own vain assumption, that his plan provides for its safe general diffusion; whereas, as has been before observed, such general distribution does not take place until the element to be disposed of has passed from her, or through some part of her solid frame-work, and in a collected form into the sea. The second objection is equally pertinent as the foregoing, and, in the shape of a question, amounts to this—that if lateral conductors, such as Mr. H. has attached to the under part of the main and orlop beams of a ship, be really useful for the discharge and transmission into the sea of an accumulation of atmospherical electricity, that might have descended by means of those of his construction along the line of masts, why not, in the name of common sense, if not of science, have such lateral conductors, leading from the different masts, laid over the surface of the upper deck of all, and by such an arrangement, reasonably, judiciously, and more scientifically, prevent the matter of lightning entering her hull, as it must now do, to reach the main and orlop beams. Here the lecturer implored all present to answer for themselves the question he had proposed; and the reporter of his lecture, as he concludes his task, solicits the same from all his readers.—*Hampshire Telegraph.*

HISTORY OF MEDALS.

(Continued from page 407.)

THERE are, likewise, to be found on medals, many different symbols by themselves; of the most remarkable of which we shall give the following table, with their signification:—

Symbols.	*Significations.*
Vases with sprigs	Solemn games.
Small chest or hamper, with a serpent leaping out	Mystic rites of Bacchus.
Anchor on Selencian medals	Coin struck at Antioch, where an anchor was dug up.
Apollo on Syrian coins on an inverted hamper	Covered tripod
Bee	Aristeus, the son of Apollo.
Laurel	Apollo.
Reed	A river.
Ivy and grapes	Bacchus.
Poppy	Ceres and Proserpine.
Corn	Ceres.
Owl and olive	Minerva.
Dove	Venus.
Torch	Diana, Ceres, or Proserpine.
Mudnis, or conic stone	The Sun, Belus, or Venus.

Symbols of Countries.

Pomegranate flowers	Rhodes.
Owl	Athens.
Pegasus	Corinth.
Wolf's head	Argos.
Bull's head	Bœotia.
Minotaur's head and labyrinth	Crete.
Horse's head	Pharsalia.
Lion	Marseilles.
Tortoise	Peloponnesus.
Sphinx	Scio.
Three legs joined, as in the Isle of Man money	Sicily.
Horse	Thessaly.
The crescent	Byzantium*
Bull	Supposed to be a river.
Ensign, with the letters "COL."	A colony drawn from one legion
Bull	Apis, strength or security.
Caduceus	Peace and concord.
Cornucopiæ	Abundance.
Pontifical hat	Priesthood.
Parazonium	Battoon of mand.
Globe on an altar, with three stars	The world preserved by the gods for the three sons of Constantine I.
Fort and gate	Security.
Tribuli, a kind of *chevaux de frize*	Unknown.
Altar or tripod	Piety.
Dolphin	Apollo.

* This appears on the early coins of Byzantium, with the legend BYZANTIN. ΣΩΤ., "the preserver of Byzantium." The reason of this was, that when Philip of Macedon besieged the city, and was about to storm it in a cloudy night, the moon shone out on a sudden and discovered him; by which means the inhabitants had time to collect their forces and repulse him. The Turks, on entering Constantinople, found this badge in many places; and, suspecting some magical power in it, assumed the symbol, and its power, to themselves; so that the crescent is now the chief Turkish ensign.

Lectisternia	Festivals.
Lituus, or twisted wand	Augurship.
Apex, or cap with strings	Pontificate.
Thensa, or chariot employed to carry images	Consecration of an empress.
Peacock	Ditto.
Eagle	Consecration of an emperor.

The legends put upon medals, are designed as explanations of them; but as the compass of even the largest coins does not admit of any great length of inscription, it has always been found necessary to use abbreviations; and in readily decyphering these, lies a considerable part of the difficulty of the science. This, however, is greater in the Roman than in the Greek medals; for the Greeks commonly insert as much of the word as is sufficient to enable us easily to understand its meaning; but it is common for those who attempt to explain letters that do not often occur, to fall into very ridiculous errors. Of this Mr. Pinkerton gives a most remarkable instance in Fortunius Licetus, a learned man, who, finding upon a coin of Adrian, the letters, Γ. ΙΔ, signifying the fourteenth year of that emperor's reign, imagined that they signified *Lucernas invenit Delta*—"Delta invented lanthorns;" and thence asscribed the origin of lanthorns to the Egyptians.

Besides the ordinary coins of the ancients, which passed in common circulation through the country, there were others of a larger size, which are now termed medallions. These were struck on the commencement of the reign of a new emperor and other solemn occasions: frequently, also, by the Greeks in particular, as monuments of gratitude or of flattery. Sometimes they were mere trials or pattern pieces; and those abound after the time of Maximian, with the words "*Tres Monetæ*" on the reverse. The common opinion is, that all the Roman pieces of gold exceeding the denarius aureus, all in silver exceeding the denarius, and all in brass exceeding the sestertius, went under the denomination of medallions; but Mr. Pinkerton thinks, that many of these large pieces went in circulation, though not very commonly, as our five and two guinea pieces, silver crowns, &c., do in this country. The finest medallions were presented by the mint-masters to the emperor, and by the emperor to his friends, as specimens of fine workmanship. The best we have at present are of brass, and many of them of two sorts of metal; the centre being of copper, with a ring of brass around it, or the contrary; and the inscription is sometimes confined to one of the metals, sometimes not. There is a remarkable difference between the Greek and Roman medallions in point of thickness; the latter being frequently three or four lines thick, while the other seldom exceed one. Very few medallions, however, were struck by the Greeks before the time of the Roman emperors; but the Greek medallions of the emperors are more numerous than those of the Romans themselves. And all these pieces, however, are of such high price, that few private persons are able to purchase them. In the last century, Christiana, queen of Sweden, procured about 300. In the king of France's collection there are 1200; a number formerly supposed not to exist; and Dr. Hunter's collection contains about 400, exclusive of the Egyptian.

Besides these large pieces, there are smaller ones, of a size somewhat larger than our half-crowns; and, by Italian medallists, are called *medaglion cini*, or small medallions. They are still scarcer than the large kind.

There is still a third kind, which have almost escaped the notice of medallists—viz. the small coins or *missilia*, scattered among the people on solemn occasions; such as those struck for the slaves on account of the saturnalia; counters for gaming; tickets for baths and feasts; tokens in copper and in lead. Some have a ship on one side; on the reverse, T, or a cross, which was the image of Priapus. Some pieces have the heads of the emperors upon one side, on the reverse only numerals, III., IV., V., &c., and the noted spintriati of Tacitus. Both these kinds appear tickets for the baths, as the number seems to denote the particular bath. Some have the head of a girl, with a vessel used at the baths in her hand. The spintriati are so immodest, that few will bear mention; but some are merely ludicrous. Of those that will just bear mention, is a man with titles around him, as chief of the games; and a woman in ridicule of the modest bath-girl. There is also one marked XIX., on which appears an imperator triumphing in a car; this car is placed on the back of a camel; and behind the imperator is a monkey mimicking him.

A fourth class of medals are called *contorniati*, from the Italian *contorniato*, "encircled;" because of the hollow circle which commonly runs around them. They are distinguished from medallions by their thinness, faint relief, reverses sometimes in relief, sometimes hollow, and, in general, by the inferiority in their workmanship.

MISCELLANEA.

Improved Mode of Planing.—There is a great novelty in invention at present at the Waterloo Saw Mills, in the Commercial Road, Lambeth, for which a patent has been obtained, for the planing of deals. Its construction is simple in the extreme, the result being produced by revolving knives, worked by steam. The deals thus planed are not only most rapidly turned out of hand, but possess a smoothness and equality not to be equalled by the ordinary means; and, moreover, the edges are "ploughed" and "toned" at the same time as the surface. Several of our most scientific men have pronounced a high opinion upon the ingenuity displayed in its construction; and the deals finished by it certainly warrant their encomium.

Extraordinary Discovery.—At the conclusion of the lecture at the Polytechnic Hall, Falmouth, Mr. Robert Hunt, the secretary, announced the discovery by himself, of a metallic plate, which would receive, by mere contact, impressions of any printed page, an engraving, or the like. This discovery was arrived at by following out the recent discoveries of Moeser, that bodies were constantly making impressions upon each other in absolute darkness, by the agency, as he considered, of latent light, but which Mr. Hunt thinks he has certain proof of being latent heat. The impression received on the metal is at first invisible, but is readily brought out by the means of any vapour. Mr. Hunt exhibited some specimens of wood and copper-plate engravings, copied from the paper into the metal. These copies exhibited every line of the original, and were far more distinct than any of the early daguerreotypes. Mr. Hunt proposes to call this new art thermography.

A New Comet.—M. Laugier, of Paris, has discovered a new comet. He states that it has a retrograde movement, and circulates in an inclined orbit of 74° 31', the ascendant node having for longitude 28° 31'. The passage to the perihelium will take place in December by 328° 23' of longitude, and at a distance from the sun expressed by 0.512. The comet continued approaching towards the earth until the 15th instant, when it was distant from it 4-10ths of the range of the terrestrial orbit. The brightness of this comet has, up to the present time, gone on increasing as to its nucleus, but there has been no sensible increase in its tail since the 2nd instant; its length is hardly 10; the width of the nebulosity has an angle of about 5°. M. Laugier has consulted the archives of astronomy, to ascertain whether the comet of 1842 was not the return one already known. The work of Pingrè mentions a comet which was seen in China in 1301, the elements of which, calculated according to the observations of the Chinese, accord, in a remarkable manner, with the results of the new calculation. It is, therefore, possible, that M. Laugier has recorded the second passage of a comet, whose period of travelling occupies more than 500 years.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, December 7, Quarterly Meeting. At half-past eight precisely.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, December 8, Edward Cowper, Esq., on Weaving. At half-past eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, December 5, Mr. Baker, on the Theory and Practice of Dying. At a quarter-past eight o'clock.

QUERIES.

Where can I obtain porous wood for the electrotype, and at what price? R. S.

What kind of metal is used for making reeds for an accordian, and where it can be got? W. W.

Where I can obtain a second-hand barrel-organ cheap? E. E. E.

How to prepare iodide of nitrogen?
R. S. N.

"G. S., jun." would much oblige an amateur, by informing him of the simplest way to prick organ barrels? J. W.

As "G. S., jun." has given so plain an account of the organ, I would thank him for the following information:—How is organ-pipe metal cast on canvass? Also, what relation the following stops are to the open diapason, their forms, and the material they are made of:—1st. Stops, Clarabella; 2nd. Ophiclide; 3rd. Contra fagotto; 4th. Corno flute; 5th. Wald flute; 6th. Suabe flute; 7th. Flageolet; 8th. Piccolo; 9th. Quint; 10th. French horn? A. C. S.

How to obtain the metal of antimony from the sulphuret? How to make cromate of iron? Also, how to take spots out of mahogany, that has been made by lime falling thereon? A. C. S.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. **113**, THIRD SERIES. | SATURDAY, DEC. 10, 1842. | No. 361, OLD SERIES.

SEMI-ROTARY STEAM-ENGINE.

FIG. 1.

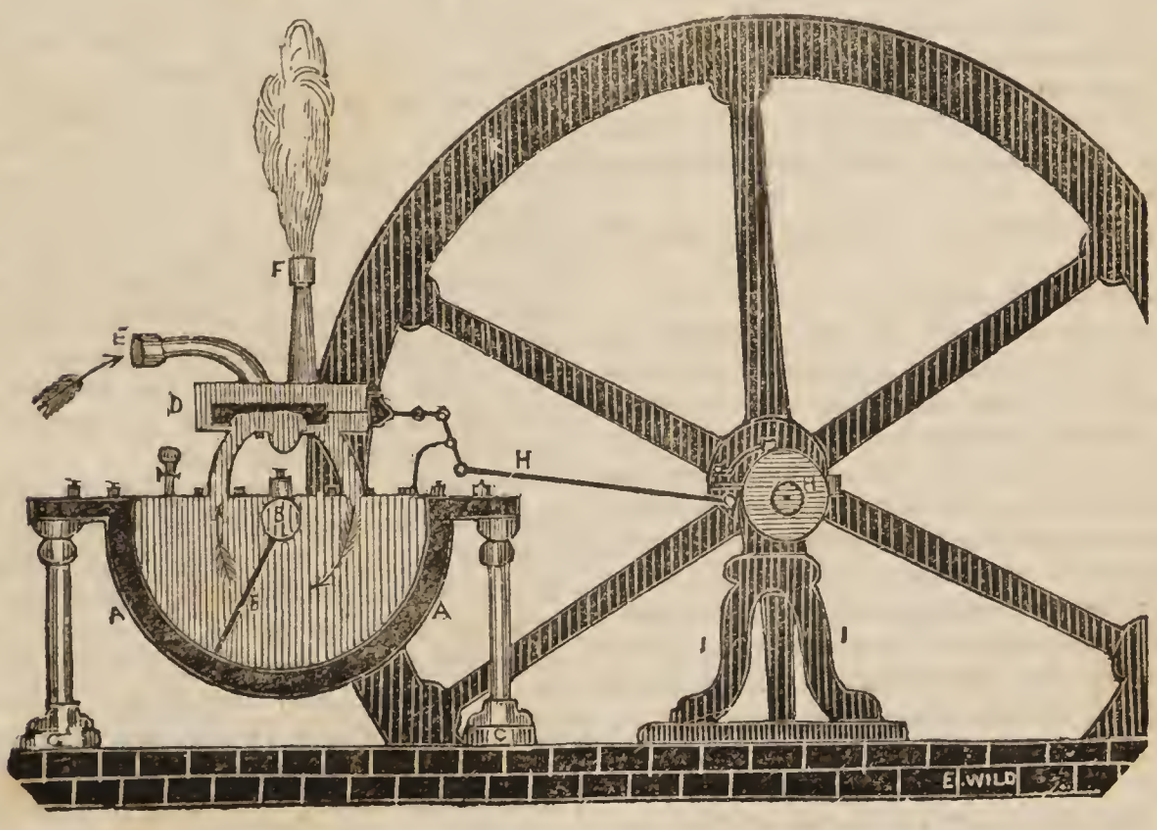
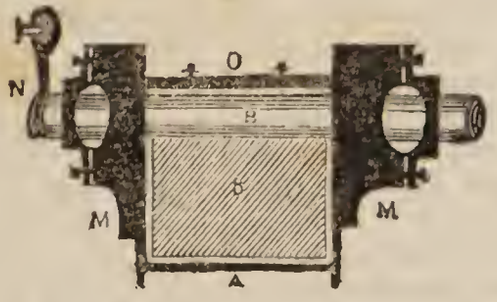


FIG. 2.



Vol. VIII.—No. 54.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

SEMI-ROTARY STEAM-ENGINE.

To the Editor of the Penny Mechanic and Chemist.

Sir,—I have sent you the drawings of a semi-rotary steam-engine, which, if you think worth insertion in your valuable journal, it is at your disposal. This plan is quite original, with regard to its general principle, which, I think, will be amusing and instructive to the readers of this Magazine.

Description of the Engraving.

Fig. 1 is an elevation of the engine, showing all the principal parts, with the exception of the connecting rod.

A A is the cylinder.

B B is the piston-rod and piston.

C C are pillars supporting the cylinder.

D is a common slide valve.

E is the receiving steam-pipe.

F the waste steam-pipe.

H H is the eccentric and rod, which works the slide by suitable connecting levers.

I I, the standard bearings for the fly shaft.

K K is the fly-wheel.

Fig. 2 is a section of the cylinder, A, showing the form of the piston and rod, B B, with its bearing, M M, which acts as the packing cases as well; the light parts showing spaces for the empen packing. N is the crank arm, fastened to the end of the piston rod, from which the connecting rod goes to the crank on the fly-wheel shaft; the two screws at O are to adjust a metallic bearing on the piston rod, which is to keep the steam from rushing out of both sides of the piston.

MANUFACTURE OF GUN-BARRELS.

(Continued from page 411.)

The first tool employed in forming the breech screw, is a plug of tempered steel, somewhat conical, with the threads of a male screw upon its surface, and by the workmen termed a screw top; this being introduced into the barrel, and worked from left to right, and back again, until it has worked out the five first threads of the screw, another less conical tap is introduced; and, when this has covered the impression of the screw as far as it is intended to go, a third one, nearly cylindrical, is made use of, scarcely differing from the plug of the breech intended to fill the screw thus formed in the barrel. The plug itself has its screw formed by means of a screw plate of tempered steel, with several female screws corresponding with the tops employed for forming that in the barrel. Seven or eight threads are a sufficient length for a plug; they ought to be neat and sharp, so as completely to fill the turns made in the barrel by the top. The breech-plug is then to be case-hardened, or to have its surface converted into steel, by covering it with shavings of horn, or the pairings of hoofs of horses, and keeping it for some time red hot, after which it is plunged into cold water.

The only thing now requisite for completing the barrels, is to give them a proper colour; as a preparation for which, their outside is first to be neatly polished with oil and emery. This being done, it was formerly the custom to give such a degree of heat as would make them blue throughout; but as this cannot be effected without a partial calcination of the surface, which, of consequence, affects the inside also, the blue colour has been for some time disused, and a brown one substituted in its place. To give this colour, the pieces are first rubbed over with aqua-fortis or spirit of salt, diluted with water; after which they are laid by till a complete coat of rust is formed upon them; a little oil is then applied, and the surface being rubbed dry, is polished by means of a hard brush and bees' wax.

Thus the common musket-barrels, for the purposes especially of sportsmanship, are made; but there are some other methods of manufacture by which the barrels are made to differ, in some respects, from those just described, and are thought to be considerably improved. One kind of these are called twisted barrels, and by the English workmen, are formed out of the plates made of stubs, formerly described. Four of these of the size already mentioned, are requisite to make one barrel. One of them, heated red hot for five or six inches, is turned like a cork-screw by means of the hammer and anvil, the remaining parts being heated successively in the same manner, until the whole is turned into a spiral, forming a tube, the diameter of which corresponds with the bore of the intended barrel. Those are generally sufficient to form a barrel of the ordinary length—i. e. from thirty-two to thirty-eight inches—and the two which form the breech or strongest part—called the reinforced part—are considerably thicker than those which form the muzzle or fore part of the barrel; one of these tubes is then welded to a part of an old barrel, to serve as a handle;

after which, the turns of the spiral are united by heating the tube two or three inches at a time to a bright white heat, and striking the end of it several times against the anvil in a horizontal direction, with considerable strength, which is called jumping the barrel; and the heats given for this purpose, are called jumping heats. The next step is to introduce a mandril into the cavity, and to hammer the heated portion lightly, in order to flatten the ridges or bars raised by the jumping, at the place where the spirals are joined. As soon as one piece is jumped throughout its whole length, another is welded to it, and treated in the same manner, until the four pieces are united, when the part of the old barrel is cut off, as being no longer of any use. The welding is repeated three times at least, and is performed exactly in the same manner as directed for plain barrels; and the piece may afterwards be finished according to the directions already given.

The operations for the French twisted barrels, is very different from that just mentioned, and much more exceptionable. It consists in heating the barrel, by a few inches at a time, to a strong red heat; one end is then screwed into a van, and a square piece of iron, with a handle-like angre, is introduced into the other. By means of these, the pieces of the heated portion are twisted into a spiral direction; which is supposed to resist the effort of the inflamed powder better than the other. To render this operation complete, however, it must be observed that, when once the several portions of the barrel have been twisted, the subsequent heats ought not to be very great, or the grain of the metal will regain its former state, and the barrel be no better for the twisting than before. To twist a barrel in this manner, also, it will be necessary to forge it at least half a foot longer than it is intended to be, that a sufficient length may be kept cold at each end, to give a sufficient purchase to the vice and twisting instrument; and these portions must afterwards be cut off before the barrel is bored; or two pieces of an old barrel may be welded to the muzzle and breech of that which is to be twisted, and cut off when the operation is over. These pieces may also be made stronger than usual, to resist the force of the vice and twisting instrument, and in order to give the latter a firmer hold, the cavity of the muzzle may be made of a square form. The English workmen are unanimously of opinion, that this method of twisting is really injurious to the barrel, by straining the fibres of the metal. At any rate, from the injudicious methods followed by the French artists, the greatest part of their barrels said to be twisted, are not so in reality, there being six or seven inches at the muzzle, and seven or eight at the breech, which are not affected by the operation.

The French ribbon barrels have a great resemblance to the English twisted ones; but the process for making them is much operose, though it seems not to possess any real advantages over that used by the English artists. A plate of iron, about the twelfth part of an inch in thickness, is turned round a mandril, and welded its whole length, in the same manner as a plain barrel. Upon this slight barrel, which is called the lining, a plate of iron, about an inch in breadth, and bevelled off at the edges, is, by means of successive heats, rolled in a spiral direction, after which it is termed the ribbon, and must have a thickness corresponding with that part of the barrel which it is to form; as it would, however, be difficult to form a ribbon of sufficient length for the whole barrel, it is made in several pieces, and, when one piece is rolled on another, is welded to its end, and the operation is continued until the lining be entirely covered. The edges are so much bevelled, that the one folds over the other about a quarter of an inch. After the ribbon is all rolled on, the barrel must be heated by two or three inches at a time, and the turns of the spiral united to each other, and to the lining, by being welded in the same manner as the twisted barrel; though, from what has been said of the construction of these barrels, it is plain that the operation of jumping cannot be admitted in them. The barrel is afterwards bored in such a manner, that almost the whole of the lining is cut out, and scarce anything left but the ribbon with which the lining is covered. The superiority of twisted and ribbon barrels over the plain kind, gave occasion to a third set, named wired barrels. These were invented by an ingenious workman at Paris, named Borris, whose method was as follows:—Upon a thin barrel, filed and dressed as usual, he rolled, as close as possible, and in a spiral direction, a temporal iron wire, about the thickness of a crow-quill, the first layer covering only the reinforced part. The turns of the wire were soldered to each other and to the barrel, with a composition which he kept a secret. The wired part was then filed smooth and bright, but not so much as to weaken it. A second layer of wire was applied over the first, extending two-

thirds of the length of the barrel; and this being smoothed and brightened like the first, a third layer was applied, which covered the two former and reached to the muzzle. The barrels made after this manner, are supposed to be much superior to others, though the supposition seems not to be well founded. It is certain that wire is not preferable to other iron as a material for gun barrels; and the solder used by Mr. Borris, in a quantity nearly equal to the wire itself, must be accounted a defect as far as it was used, for no metal as yet has been found equal to iron for the purposes of gunsmiths, so that, by the use of so much of that solder in the composition of the barrel, it must be, undoubtedly, weaker than if it had been all made of iron. We are not to suppose the wire absolutely free from flaws; and even though it were, there will always be small cavities between its turns, which the solder cannot fill completely. Besides, as the operation of turning was performed by Mr. Borris upon a barrel which had been previously bored and dressed within the repeated heats to which it was afterwards subjected in soldering, if they did not cause it to warp, at least rendered it so rough, that it was necessary to fine bore it afterwards. The only advantage, therefore, which these barrels were found to possess, was their beautiful appearance, which was greatly over-balanced by the circumstance just mentioned, as well by the extravagant prices at which they are sold; a single barrel being sold at 5l., and a double one at twice that sum, whence the sale of them never answered the expectation of the inventor; and after his death, nobody thought of making them.

(To be continued.)

BEACON ON THE GOODWIN SANDS.

The great loss of life annually occurring on our eastern coast, is universally known; and the Goodwin Sands, in particular, being situate at the very portal through which passes the most active commerce in the world, are the scene of the most frequent and fatal shipwrecks. There is no other spot perhaps, on the face of the earth, so well known for its dangers, or so much dreaded by seamen. Nor are its terrors diminished by popular opinion; on the contrary, it is commonly believed that the Goodwin Sands swallow up and engulph, irrecoverably, whatever is thrown upon them. But, however desirable it may have been thought to contrive such a refuge, the first experiments made towards it have always seemed to prove its impracticability; and if the refuge beacon now standing be remarkable for its simplicity—a mast, with a gallery capable of holding thirty persons, standing in the midst of the waves, with a frightful surf often foaming around it—it is only one of many proofs afforded by the history of inventions, that the simplest means are often the last arrived at. The refuge beacon erected on the Goodwin Sands, and which has now sustained, without injury, the violence of two most tempestuous winters, is the result of many attempts, of long, anxious, persevering exertions, and of favourable opportunities, afforded me by the Lords of the Admiralty. It is a contrivance matured by experiment; its stability, therefore, is due, not to chance, but to the care bestowed on it. And since the most competent judges pronounce it well calculated to attain the object in view—namely, the preservation of life—it is a matter of no small triumph to have established it firmly in so dangerous a situation. In carrying on the survey of the Thames, it was found expedient, as the work proceeded seawards, and the receding landmarks grew indistinct, to erect fixed marks on the different sands. The first of them was nothing more than an iron bar driven into the sand, with a flagstaff affixed to it. This stood but a tide or two, and was succeeded by various modifications of the same simple plan, stays being added to support the shaft; but in vain—the marks erected in this manner all yielded to the first gale of wind. It then appeared that some foundation was wanted to enable them to resist the force of the waves. To remedy this defect, the bar was fixed in a broad cross of wood, from the extremities of which, chains were attached to the staff, and, after many trials, success was attained by this means.

"The results of the experiments above related, joined to the knowledge of the lamentable loss of life annually taking place on the Goodwin Sands, induced the persuasion, that since it was found practicable to fix a beacon on them, it was an imperative duty to erect one calculated for the preservation of life.

It ought to be observed, that the Goodwin Sands are, to a great extent, dry at low water, and, as vessels which strike on them seldom go to pieces in a single tide, the probability is, that some of the wrecked crew would be enabled to reach the sand during that interval, and the safety beacon would then become their only refuge

It is well authenticated, that numbers have reached the Sands in safety, who were afterwards swept away by the returning tide, before assistance could be rendered them.

It is obvious, that the essential principle of this beacon is, that it rests upon a base not easily broken or displaced, and that the mast, with its gallery, the only superstructure, offers little or no resistance either to the wind or waves, so that its strength lies in its simplicity. If it be objected, that there is nothing in its mode of construction which holds out a promise of perpetuity, the answer is, that it can be replaced at a trifling expense; and, still farther, that it has withstood the storms of two winters, one of them the severest on record for a long period. So long as it stands, it holds out a chance to the distressed, and, if it falls, it can be easily renewed; at all events, it has successfully passed through severe trials, and exhibits, at least, a highly interesting experiment.

The shaft or mast (forty feet in height, and twelve inches in diameter) is sunk into the sand, through a strong frame of oak, in the form of a cross, firmly secured by four long bars of iron, and laden with several tons of ballast, chalk, &c. The mast is also sustained by eight chain shrouds, in pairs, and attached to iron piles, seventeen feet long, which are driven close down into the sand, and are backed by mushroom anchors to prevent their coming home, or towards the mast.

On the shaft is fitted an octagon gallery, capable of holding thirty or forty persons, and never less than sixteen feet above high-water mark. Beneath this gallery there is temporary safety for twenty persons more.

The mast is also fitted with a light top-mast, on which a blue flag (always at hand) can be hoisted as a signal when aid is required from the shore; but which is kept struck or down, to give the whole the appearance of a wreck—thus answering the double purpose of a beacon of warning and a place of refuge.

Directions how to proceed, to those persons who may fortunately succeed in reaching the safety beacon, are given in eight different languages; and bread and water, with a small supply of spirits, are always left upon the beacon, properly protected from the weather.

To the beacon is also appended a chain ladder of easy ascent, as well as cleets to the mast, and a large basket chair is kept in readiness, with ropes and blocks, to aid and secure the exhausted."

USES OF THE ALKALIMETER.

Soda and potash are never met with in a state of purity in commerce. Of these alkalies, the least impure are those which contain merely carbonic acid and water; afterwards come those which contain earths, carbonate of lime, sulphur, charcoal, and particularly the alkaline muriates and sulphates, of which it is but too true, that for some years a fraudulent mixture has been made, extremely prejudicial to manufacturers, in which alkali is used.

For a long time it has been a great desideratum to discover a prompt and easy process for trying potash, soda, natron, and the other alkalies, which might be both within the reach of buyers, and certain in its results. The areometer, so convenient in the spirit trade, and even for trying the sulphuric, nitric, and muriatic acids, is insufficient in this respect. It has been successively suggested to employ various acids, and some of their combinations with precipitable bases. The sulphuric acid, pure and uncombined, is considered the most suitable for this purpose, as its price is low, it can every where be procured, and can be brought to the same state of concentration. He found the most expeditious process for judging comparatively of the value of various specimens of alkali, to consist in ascertaining how many centimes of their weight they require of sulphuric acid for their saturation.

The alkalimeter is a glass tube eight or nine inches long, and seven or eight lines in diameter. At one end it is closed, the other terminates in a small funnel, with a beak connected with the tube by a neck, the aperture of which is about two lines and a half in diameter. Upon the shoulder which supports this neck is a hole, for letting the air out and in. In order to facilitate the carriage of the instrument, it is furnished with a tin case, without a bottom, having a lid; the other part being, like the former, indicated by dotted lines, is a tube open at both ends, and upon which, in order to fasten the lid, there must be a projection. The alkalimeter ought to contain easily thirty-eight grammes, or seventy-six demigrammes; because each division, or degree, which we trace afterwards upon the instrument, represents a demigramme of this liquor, which it is extremely important to proportion accurately as follows:—

Take concentrated sulphuric acid, or oil of vitriol of commerce, at 66° of Banme's areometer; afterwards put in equilibrium, in a good balance, a vessel of porcelain or

glass, and pour into it a given weight of the above acid, say a hectogramme; add carefully, on account of the caloric which is liberated, nine hectogrammes of pure water, then stir it well with a glass rod, and then put it into a glass bottle, which must be corked up, that no alteration, either by dust or by evaporation, may take place.

The alkalimeter is then graduated by given weights of this liquor, in the following manner:—Place the instrument in perfect equilibrium in a balance, and introduce into it, very exactly, two grammes of the test liquor; place the tube afterwards in a vertical position, and mark the level by a small scratch with a diamond; pour in once more, and all at one time, thirty-six grammes of the liquor, and mark this level also by a scratch; after this, empty the instrument, and draw a mark on the other four vertical parallel lines; and forming three spaces of about one line between each, mark on the two extremities two small transverse lines, making right angles with the other four; then write 0 in the upper part, and 72 in the lower; pour liquor into the tube afterwards, up to the point marked 72; put the instrument once more in equilibrium, and introduce, one after the other, seventy-one demigrammes of the test liquor, taking care to mark, each time, one point in the middle scale: this being accomplished, trace regularly, by four and four points, lines across the three scales; then trace, in the same manner, upon all the other points, lines through the middle scale only: engrave, after this, on one side, and opposite to each fourth division, the numbers 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68, and 72. The marks are easily made with a glazier's diamond.

Besides the alkalimeter and the test liquor, the following articles must be procured:—

1. Syrup of violets.

2. A small balance: those for weighing gold coins will answer; we may, however, employ smaller.

3. Weights of two drachms, forty-four grains, and two thirds of a grain.

4. A measure of a demidecilitre, or, rather, according to the old system, the small measure answering to the sixteenth of a Paris pint (those which have no lids are preferable); this small vessel is intended to give any two measures of water, and its capacity is not of very great consequence. Any other vessel of nearly the same capacity will answer.

5. Common drinking-glasses; those whose edges are turned outwards should be preferred. If common glasses only are used, before decanting a portion of the liquor into them, as above described, we must give a slight coating of oil, fat, or grease, to part of their orifice, which will present an irregular flowing down the outer sides.

6. Small slips of wood, or matches from which the sulphured ends have been taken off.

7. A bottle of water and an earthen plate.

8. Lastly, for soda, hard American potash, and natron, there must be a metal pestle and mortar, of about six inches in its greatest diameter.

The whole being arranged, any given alkali may easily be tried; we shall take potash as an example.

(To be continued.)

MISCELLANEA.

Invention for the Consumption of Smoke.—A furnace has recently been invented by Mr. Juckes, for the perfect combustion of smoke. He has secured it by patent; and it is, in many respects, so useful and ingenious, that it will, probably, become extensively patronised, as its merits are made known. The first peculiarity which strikes the eye, is the total absence of smoke from the chimney of a furnace under a boiler which works an engine of twenty-horse power. This of itself implies a perfect and entire combustion of the fuel, the smoke which is given off, and causing the offensive nuisance, being merely particles of coal separated on the first application of heat in the process of destructive distillation, when it is submitted to the action of heat in a fire or furnace. To make this portion of the fuel available for the production of heat, has excited much inquiry and ingenious speculation; and, in this case, the results are obtained by the mechanical arrangements of the furnace, which are made to effect the perfect chemical decomposition of the fuel. The fire-grate is a series of fire-bars, forming an endless chain, which, by the steam-engine (and the same may be done by an occasional application of manual or mechanical power) progresses with the fuel in an active state of combustion under the boiler, at the rate of about one inch each minute. The fuel at first introduced, parts with more volatile products, which are carried over those portions of the fuel, where the production of the heat is most perfect and intense, and thus

every part of it is made available to the support of combustion, which is rendered still more complete by the admission of atmospheric air through each of the bars, by which oxygen gas is admitted, sufficient for the conversion of the whole of the incandescent materials into gaseous products. No fuel is wasted, as is apparent, from the entire absence of carbon or smoke in the chimney. The most prominent feature is the perfect uniformity of heat under the boiler, which is also secured without the constant attendance of the stoker, as a sufficient charge can be given in the hopper outside the furnace-door to last upwards of an hour, which is slowly carried on by the rotary motion of the fire bars; this furnace door, acting in a perpendicular manner, being so regulated as to give the requisite quantity of fuel. Here the fire-bars are always feeding, taking in the fuel at one end, while they reject the scoriæ at the other; being constantly free from clinkers, the supply of the requisite quantity of oxygen gas for the support of combustion through the fire-bars, is always uniform and unimpeded; and the bars are as clear in the evening as they were when they commenced working in the morning. The furnace is also admirably adapted for the consumption of the smaller particles, or of the refuse coal, which accumulates to even mountains in the neighbourhood of many of our collieries, particularly to the north; and, to render which available, has excited a great deal of attention and inquiry. We understand, that the furnace of Mr. Juckes has been the subject of the most unqualified approbation of Professor Buckland, of Sir M. I. Brunel, &c. The saving in fuel alone, we are assured, is about forty per cent. The plan is applicable to railway or steam-boat engines.—*Herald.*

Wonders of the Microscope.—Ehrenberg has discovered with the microscope, in soft earths, &c., that chalk consists of small elliptical bodies, formed of articulated rings, and are in size from the 2500th to the 6000th of an inch; that calcareous incrustations consist of small articulated needles, with a tendency to a spiral; that porcelain, earth, or kaolin, is composed of round bodies the 400th of an inch; that mixed earths—as potters' clay, and siliceous and argillaceous substances—afford facts of like kind. Fragments of insects, wings of fuci, sea-weed, woods, &c., are shown upon an exaggerated scale. Hairs of an infant appear like tubes two inches in diameter. A small portion of the fine skin of the human pericardium, exhibits the courses of the arteries and veins. It reveals the interior conformation of fleas and spiders. The sting of a bee is a monstrous barbed weapon, four feet long. The lancets of the horse-fly are sabres about two feet in length. Small animalculæ, in a drop of water, are seen preying on each other. Skeleton larvæ are beautifully developed, exhibiting even the vesicle of air which enables them to rise or descend in water. Worms found in stagnant ditches, the natural size of a thread, appear like a boa-constrictor.

Eclipses in 1843.—In the course of next year there will be three eclipses—viz., two of the sun and one of the moon, of which only the latter will be visible in England. The first of these phenomena will be an annular eclipse of the sun, on Tuesday, the 27th of June, commencing at twenty minutes past seven in the evening, and being visible chiefly in the Great Pacific Ocean and in South America. The second is a partial eclipse of the moon, in the night of Wednesday, the 6th of December, which will be visible in these parts, commencing at eighteen minutes past eleven, and when two digits of the lower disc of the moon will be eclipsed. The third and last is a total eclipse of the sun, early in the morning of Thursday, the 21st of December, and invisible here, but visible in the Chinese empire, Hindostan, the Islands of Ceylon, Sumatra, Borneo, &c.

INSTITUTIONS.

LECTURES DURING THE WEEK.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, December 15, Edward Cowper, Esq., on Calico Printing, At half-past eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, December 12, T. Williams, Esq., M. B., on the Mental and Physical Characteristics of the various Races of Mankind. At a quarter-past eight o'clock.

QUERIES.

The best method of cleaning leaden inkstands? Mine are much stained with ink, and, though I have them frequently scoured, they present a very dingy appearance.

C. S. M.

Where can small magnetic bars be obtained, about the size of a needle, and the probable price.

E. G. H.

"S. E." thanks "G. S., Jun." for his kindness, and will feel obliged if he will afford still further information on the subject—viz., the shape of the pedals, and the way in which the trackers are attached to them; also, how

the trackers are attached to the bass keys, in order to pull them down? Are the trackers above the keys, or fastened to them, or do they merely rest on them? How is a swell to be effected in an organ with only one row of keys? In the letter-press explanatory of the engravings, there are references to some letters that "S. E." could not perceive—viz., *w*, *x*, *y*, &c.

Will "G.S., Jun." be kind enough to give a little information as to the manner of fixing the plate (by which the pricking of organ barrels is managed) on the end of the barrel; and, also, in marking the barrel, does the person doing it mark the air, bass, and chords, at the same time, or does he mark the air first, and then go over it again for each of the chords? Also, what description of stops the following are; I met with them in reading a description of the new organ lately erected at Worcester:—The Bourdon (which appears to go to C C C), Tenoroon Diapason, Quint, Wald Flute, Snabe Flute, Oboe Flute, Doublette, and Echo Cornet. A. T. Z.

If "G. Lodge" would afford any information respecting his plan for causing house bells to ring at any distance, without cranks or wires, &c., he would much oblige J. B. F.

Is there any restorative for pale seal oil; for I find that, after the oil has been used in the solar lamps, and that, if left in the lamps for a few weeks, and although a fresh cotton be put on, they will not maintain a good flame for more than an hour or two. It has the same fault if taken out of the lamps, and put into a bottle? If any of your chemical correspondents will supply the required information, it would be a great saving in public buildings, where lamps are only occasionally wanted. J. B. F.

One grand law of light is, that the angle of incidence is always equal to the angle of reflection; or, in other words, that the incident and reflected rays form equal angles with the reflector. According to this rule, parallel rays falling on a spherical concave mirror, will be reflected into one point, called the focus. I have been told, that there is an exception to this where the concavity is great, say 160°, which, making two or more points, is called a spherical aberration; and that, in this case, parabolic reflectors concentrate the rays into one point, where spherical will not. I have drawn diagrams, but cannot, theoretically make out the anomaly (for such it appears to me), without deviating from the above general law, but find that the only difference the greater or less concavity make to be in altering the focal distance. Perhaps some of your correspondents, who have opportunities of pursuing the subject practically, would explain to me the course, and attribute my trespass to IGNORANCE.

If any of your numerous readers should be in want of a powerful Smee's battery, at the small price of 8s. (sold at the shops for 12s. or 14s.; also a very neat electrotype apparatus, on an improved principle, large enough to electrotype fifteen seals, or three large medals, they are deposited at Mr. Barlett's, Brittain Terrace, King's Road, Chelsea. A. C. R.

In your Magazine of Oct. 22, your correspondent, "G. Lodge," says he has succeeded in an experiment of vast importance to bell-hangers—that is, by causing a bell to ring without cranks or wire, now I should like to know how he can hang a number of bells without leading the work from the pull to the bell, for the two must be connected some way, and I do not think it possible to do so without boring holes. I have a plan of ringing a bell a long distance (from a yard to fifty miles), but not for one penny per foot. My bell does not act by any chemical contrivance whatever, as I am inclined to think Mr. Lodge's does; and if so, his plan will not answer for dwellings. T. D. BAMBER.

ANSWERS TO QUERIES.

"A. C. S." may obtain chromate of iron, by adding chromate of potass to a solution of sulphate of peroxide of iron: the chromate of iron will be precipitated. H. DEMPSEY.

If "S. E." resides in London, and will pay a visit to Messrs. Flight's and Robson's music room, St. Martin's Lane, he may see organs in various stages of forwardness, from which he would be likely to gather some of the information he requires. J. B. F.

To make Tongues for Accordions.—Take a piece of common watch-spring, which can be got of any watchmaker, and, if too thick, grind or file it to about the required thinness. Drill a hole for the rivet, and fix it in the plate, but not fasten it, and with a penknife from underneath, scratch the tongue down each side and the end. Take it from the plate and file it to the required size; place it again to the plate, and rivet it fast. To tune it, place a small wedge, of any hard wood, under the tongue, and, if you wish to flatten the note, file a little off towards the end nearest the rivet; and if to sharpen it, off the upper part of the vibrating end. A little practice will enable him to accomplish it. I am persuaded a watch spring is preferable in many respects to brass. The same plan must be adopted in tuning seraphines. If there is any jarring of the note when blown upon, it is caused by the tongue scratching the plate in vibrating. The same cause will also prevent it speaking. J. WARD.

"G. S." can purchase accordion tongues at Tulley's, 30, Belton Street, Long Acre.

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

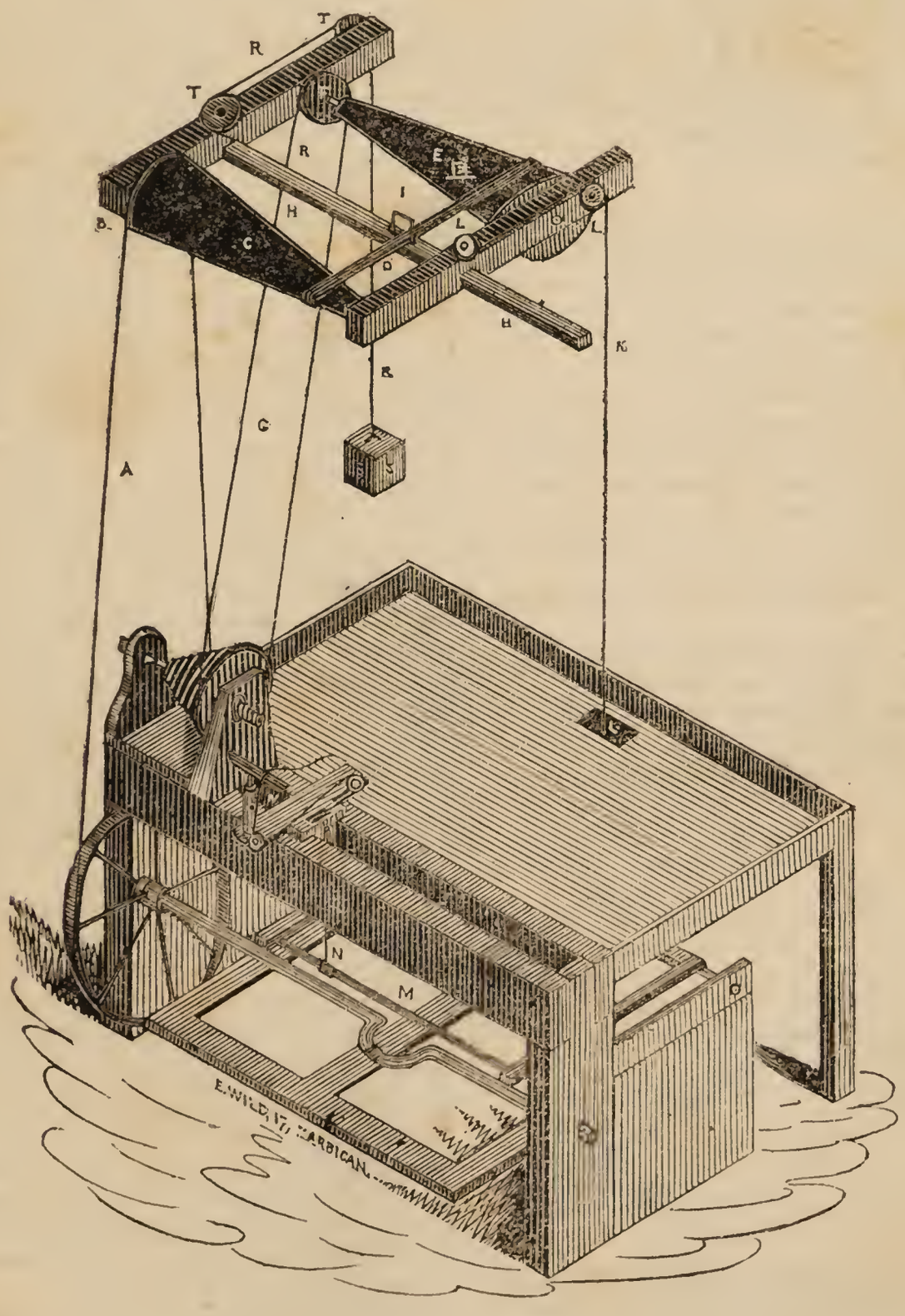
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. 114, THIRD SERIES. | SATURDAY, DEC. 17, 1842. | No. 362, OLD SERIES.

PLAN FOR REGULATING THE SPEED OF THE LATHE MANDRIL.



Vol. VIII.—No. 55.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

PLAN FOR REGULATING THE SPEED OF THE LATHE MANDRIL.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

SIR,—I beg to submit the enclosed plan for regulating the speed of the lathe mandril in surface turning. Perhaps some of your talented correspondents would give their opinions of it. If the string or band, N, be attached to the tool used in turning, as the tool is pressed towards the centre of the mandril, it will raise the lever, M, which will act upon the slide, H, by means of the string or band, K, so as to guide the band, D, towards the ends of the cones, C and E, and, by that means, increase the velocity of the lathe mandril.

I am yours, &c.,

M. N.

Description of the Engraving.

A, the band which goes over the fly-wheel of the lathe and over

B, a pully attached to the cone,

C, over which the band,

D, runs, and over the other cone,

E, to which the pulley,

F, is attached; over which the band,

G, runs, and over the pulley on the mandril of the lathe.

H, a slide, to which is attached the guide,

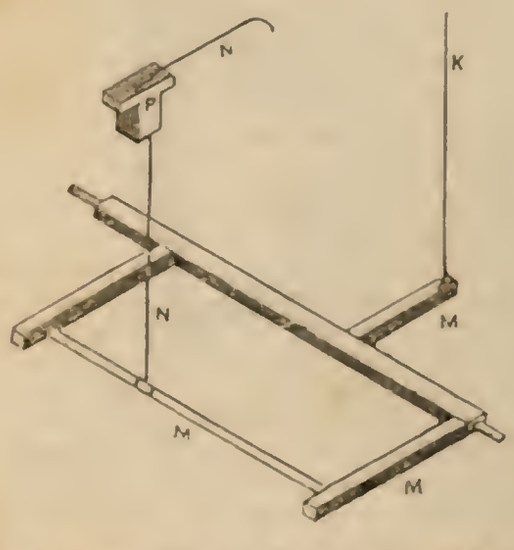
I, to the one side of which is attached the band,

K, which runs on the guide pulleys,

L, and is attached to the lever,

M, under the lathe, and to which, in front, is attached the band,

N, which goes through the piece,



P, and over the pulley in it; this band, N, is attached to the tool used in turning; to the other side of the guide, I, is attached the band,

R, to the end of which is attached the weight,

S S, and which band runs over the guide pulleys, T.

MANUFACTURE OF GUN-BARRELS.

(Continued from page 428.)

THE Spanish barrels have long been held in great estimation, both on account of their being formed of better iron than those of other countries, and likewise from an opinion of their being more perfectly forged and bored. Almost all the Madrid barrels are composed of the old shoes of horses and mules, which are all collected for the purpose. They are manufactured first by welding longitudinally, and then being joined together in four or five pieces, like the English barrels made from stubs, as already mentioned. In this, and, indeed, all other operations for making gun-barrels, an immense waste of the iron takes place; but that of the Spanish iron is by far the greatest—a mass of forty or forty-five lbs. being required to make one barrel, which, when rough from the forge, weighs only six or seven pounds, so that from thirty to thirty-eight pounds are lost in the hammerings. It may, perhaps, be doubted, whether the iron be really purified by this waste; for it is certain that, by long-continued working in the fire, it may be rendered totally useless and destroyed. Neither can we be assured that the other advantages pretended to result from their method of manufacture, are of any consequence. The Spanish artists likewise value themselves on giving the inside of their barrels a very high polish, but the advantage of this, as has already been observed, is extremely dubious. The only thing requisite in a gun-barrel is, that it do not lead—that is, that the mark of the bullet be not perceived on the inside after it has been discharged, by some of the lead rubbed off as it passes through. In the opinion of very good judges, therefore, it is better to take a barrel immediately after it has undergone the operation of fine boring, than to give it any higher polish; and, in support of this opinion, M. de Morelles, an author of great reputation, informs us, that he has seen a rough barrel from the borer, throw a charge of shot deeper into a quire of paper, than one which was highly polished within, though the length of the bore and charge was the same in both.

As the Spanish iron is universally allowed to be excellent, it has not been unreasonably supposed, that the superiority

of the barrels manufactured in that kingdom, is owing more to the goodness of the materials, than to the skill of the workmen. It must be observed, however, that instead of making the plates overlap a little in the place where they join, they give one of them a complete turn; so that every Spanish barrel may be said to be double throughout its whole length. The different portions of the iron are also forged in such a manner, that the grain of the iron is disposed in a spiral manner; whence it has the same effect with a ribbon or worsted barrel. The outside is finished by turning them in a lathe, whence, probably, they are always less elegantly wrought than the French or English pieces. The great value put upon them, is also thought to be more owing to fancy, than to any real good qualities they possess. Formerly they were made from three to three feet and a half long, their bore being such as to admit a bullet from twenty-two to twenty-four in the pound, and their weight from three to three pounds and a half. The reinforced part extends two-fifths of the length, and at ten or twelve inches from the breech is placed a sight, such as is usually put upon rifle-barrels, or those intended only for ball. According to Espinasarquebot's bearer to Philip IV., the weight of a Spanish barrel ought to be five pounds and a half, when their length is forty-two inches; but both weight and length are now much reduced, they seldom exceeding the dimension already mentioned.

Having now described the method of forging barrels, we shall next proceed to give an account of those imperfections to which they are sometimes liable, and which render them apt to burst or recoil with violence. The principle of these, are the chink, crack, and flaw. The first is a small rent in the direction of the length of the barrel, the second across it, and a third is a kind of scale or small plate, adhering to the barrel by a narrow base, from which it spreads out, like the head of a nail, from its shank, and, when separated, leaves a pit or hollow in the metal. The chuck, or flaw, is of much worse consequence than the crack in fire-arms—the force of the powder being exerted more upon the circumference than the length of the barrel. The flaw is much more frequent than the chink—the latter scarce ever occurring but in plain barrels, formed out of a single plate of iron, and then only when the metal is deficient in quality. When flaws happen on the outside, they are of no great consequence; but in the inside they are apt to lodge moisture and foulness, which corrode the iron, and thus the cavity enlarges continually, till the piece bursts. This accident, however, may arise from many other causes besides the defect of the barrel itself. The best pieces will burst when the ball is not sufficiently rammed home, so that there is a space between it and the powder. A very small windage or passage for the inflamed powder between the sides of the barrel and ball, will be sufficient to prevent the accident; but if the ball has been forcibly driven down with an iron ramrod, so as to fill up the cavity of the barrel very exactly, the piece will almost certainly burst; if only a very small space be left between it and the powder, as the greater the space is, the more certainly does the event take place. Of this Mr. Robins gives a remarkable instance, accounting, at the same time, for the phenomenon:—"A moderate charge of powder," says he, "when it has expanded itself through the vacant space and reaches the ball, will, by the velocity each part has acquired, accumulate itself behind the ball, and will thereby be condensed prodigiously, when, if the barrel be not of an extraordinary strength in that part, it must infallibly burst. The truth of this I have experienced in a very good Tower musket, forged of very tough iron; for, charging it with twelvepenny-weight of powder, and placing the ball loosely sixteen inches from the breech, on the firing of it, the part of the barrel just behind the bullet was bulged out to double its diameter; and two large pieces, of two inches in length, were burst out of it. A piece will frequently burst from having its mouth stopped up with earth or snow, which accident sometimes happens to sportsmen in leaping a ditch, in which they have assisted themselves with their fowling-piece, putting the mouth of it to the ground; and, when this does not happen, it is only to be accounted for from the stoppage being extremely slight. For the same reason, a musket will certainly burst, if it be fired with the muzzle immersed only a little even in water. It will also burst from an overcharge; but when such an accident happens in other circumstances; it is, most probably, to be attributed to a defect in the workmanship, or in the iron itself. These defects are, principally, an imperfection in the welding, a deep flaw having taken place, or an inequality in the bore, which last is the most common of any, especially in the low priced barrels. The reason of a barrel bursting from an inequality in the bore is, that the elastic fluid, set loose by

the inflammation of the powder, and endeavouring to expand itself in every direction, being repelled by the stronger parts, acts with additional force against the weaker ones, and frequently bursts through them, which it would not have done, had the sides been equally thick and strong throughout. With regard to defects arising from the bad qualities of the iron, it is impossible to say anything certain. As the choice of the material depends entirely on the gunsmith, the only way to be assured of having a barrel made of proper metal, is to purchase it from an artist of known reputation, and to give a considerable price for the piece. The recoil of a piece becomes an object of importance only when it is very great; for every piece recoils in some degree when it is discharged. The most frequent cause of an excessive recoil, is an inequality in the bore of the barrel; and by this it will be occasioned, even when the inequality is too small to be perceived by the eye. The explanation of this upon mechanical principles, indeed, is not very easy; for, as it is, there is an invariable law, that action and reaction are equal to one another, we should be apt to suppose, that every time a piece is discharged, it should recoil with the whole difference between the velocity of the bullet and that of the inflamed powder. But were this the case, no man could fire a musket without being destroyed; for the bullet flies out only with a velocity of 1700 feet in a second, or much more, while that of the powder, as calculated by Mr. Robins, is not less than 7000 feet in the same space. But, was the recoil to be made with the difference of the velocities, or with one-half of it, it is plain that no man could bear it. The same thing, therefore, must take place in the recoil of a musket, which Dr. Priestly observed in his experiments on the explosion of inflammable and dephlogisticated air—viz., that the force is exerted much more upon the part farthest from that where the inflammation begins, than upon those next to it. At any rate, however, the strength of the recoil will always be found proportionable to the weight of the piece—that is, the lighter the piece is, the greater the recoil, and *vice versa*. The recoil may be increased by anything that retards the passage of the shot; whence it is also augmented by the foulness of the barrel by repeated firing. M. de Marolles observes, also, that a piece will recoil, if, from the breech-plug being made too short, some turns of the screw remain empty; as in these a part of the powder is lodged, which forms an obstacle to the explosion; though in what manner this takes place is not very apparent, as, though the powder lodged there, might contribute little or nothing to the force of the explosion, it can scarce be shown to stand in the way of it. The same author likewise informs us, that a barrel mounted upon a very straight stock, will recoil more than upon one that is considerably bent. Sometimes, also, a fowling-piece will recoil from the sportsman applying it improperly to his shoulder; though this last circumstance seems likewise inexplicable. It is most probable, therefore, that the supposed greater recoil taken notice of in this case, arises only from the usual recoil being more sensibly felt in one position than another.

(To be continued.)

METHOD OF PAINTING IN EMAMEL.

Enamel painting is performed on plates of gold and silver, and most commonly of copper enameled with enamel; whereon they paint with colours which are melted in the fire, where they take a brightness and lustre like that of glass. This painting is most prized of all for its peculiar brightness and vivacity, which is very permanent; the force of its colours not being effaced or sullied with time, as in other painting, and continuing always as fresh as when it came out of the workmens' hands. It is usual in miniature, it being the more difficult the larger it is, by reason of certain accidents it is liable to in the operation. Enameling should only be practised on plates of gold, the other metals being less pure. Copper, for instance, scales with the application, and yields fumes, and silver turns the yellow white. Nor must the plate be made flat, for, in such case, the enamel cracks; to avoid which they usually forge them a little round or oval, and not too thick. The plate being well and evenly forged, they usually begin the operation by laying on a couch of white enamel (as we observed before) on both sides, which prevent the metal from swelling and blistering; and this first layer serves for the ground of all the other colours. The plate being thus prepared, they begin at first by drawing out exactly the subject to be painted with red vitriol, mixed with oil of spike, working all parts of the design very lightly with a small pencil; after this the colours, which are to be before ground with mortar of agate extremely fine, and mixed with oil of spike somewhat thick, are to be laid on, observing the mixtures and colours that agree to the different

parts of the subject, for which it is necessary to understand painting in miniature; but here the workman must be very cautions of the good or bad qualities of the oil of spike he employs to mix his colours with, for it is very subject to adulterations. Great care must likewise be taken, that the least dust imaginable come not to your colours, which you are either painting or grinding, for the least speck, when it is worked up with it, and when the work comes to be put into the reverberatory to be made red hot, will leave a hole, and so deface the work.

When the colours are all laid, the painting must be gently dried over a slow fire to evaporate the oil, and the colours afterwards melted, to incorporate them with the enamel, making the plate red-hot in a fire, like that which the enameller uses. Afterwards that part of the painting must be passed over again, which the fire hath anything effaced, strengthening the shade and colour, and committing it again to the fire, observing the same method as before, which is to be repeated till the work be finished.

USES OF THE ALKALIMETER.

(Continued from page 230.)

Weigh exactly one decagramme, or two drachms 44¾ grs. of potash; put it into a glass, and pour upon it about four-fifths of a demi-decilitre of water; facilitate the solution of the potash by stirring it with a small slip of wood, three or four times in an hour and a half, a minute at each time. When you think the solution is effected, pour it into a small tin measure, which you then fill up with water; pour it back again into the glass, into which you must still pour a measure full of pure water; stir this new mixture also three or four times within half-an-hour, in order to facilitate the precipitation of a slight sediment, which soon falls down. This sediment being completely formed, slope the glass with caution, in order to fill with clear liquor the small measure; then empty this last into another large glass; after this, place round the edges of a plate, drops of syrup of violets; pour, also, into the alkalimeter test liquor, until the line marks 0; take it afterwards with the left hand, inclining it upon the glass which contains the moiety of the clean alkaline solution. The acid liquor will fall into it by hasty drops, or in a very small thread, which may be moderated at pleasure, by retarding the entrance of the air at the lateral hole or vent, upon which must be placed the end of the finger; at the same time, with a small stick or match, assist the mixture, and facilitate the development of the carbonic acid, which is manifested by effervescence. When the alkalimeter is emptied to about the line marked 40, try if the saturation approaches, by drawing the small stick from the mixture, and resting it upon one of the drops of syrup of violets, which should become green, if the potash is not of a very inferior quality. If, on the contrary, the violet colour is not altered, or, what would be worse, if it be changed into red, there would be, in the first case, an indication of saturation, and, in the second, a proof of supersaturation. But this is not the case with good potashes: at that line, the liquor tried can alter the syrup of violets into green only; or cause to return to the violet, and even to the green, the drops which had been changed into red at the time of a former trial: we must, therefore, in general, add more acid, which occasions a new effervescence; this addition must be always made with caution, and we must touch every time a drop of syrup of violets, in order to stop. When, at last, the latter assumes a red hue, then, after having restored the alkalimeter to a perpendicular position, in order to see at what line the testing liquor stops, you must reckon one degree less, in order to compensate the excess of saturation. The mean term of potashes is 55: this implies that they require for their saturation fifty-five hundredths of their weight of sulphuric acid.

Let us now examine the operation we have described. We have, on the one hand, put into solution one decagramme of potash; nevertheless, we have only taken definitively the moiety of this solution; thus it is reduced to 100 half-tenths of the grammes. On the other hand, we have put into the alkalimeter thirty-eight grammes of a liquor composed of one part in weight of sulphuric acid, and of nine similar parts of water. The seventy-six demi-grammes of the test liquor, therefore, contain seventy-six demi-tenths of grammes of effective acid; and if it required fifty-five demi-grammes of this liquor, in order to saturate the proved potash, we are evidently well founded in saying, that this alkali has absorbed a quantity of sulphuric acid equal to fifty-five hundredths of its weight.

Each trial, however, is made without calculation; a single weight is sufficient, and the instrument finishes the rest almost alone.

In some countries from which potash is exported, there are inspectors of this article; but they have not had, until this moment, any method of inspection which could be compared with that described in this memoir.

It requires but a very slight modification in this process, to apply it to the trial of sodas. In place of one decigramme—i. e., ten grammes, we must put about ten and a half, or, if we please, three drachms in a middle-sized metal mortar, and pound them strongly for five minutes, so as to produce a fine powder, of which we must weigh exactly one decigramme; or, what is very near that quantity, two drachms and forty-four grains, and two-thirds of a grain, which we afterwards put into the water, as is said above of potash.

Sicilian ashes, or the ashes of the rocket plant, and other similar alkaline substances, are tried like sodas.

Natron, tartar-ashes, tobacco-ashes, &c., also require to be bruised before weighing the ten grammes for the trial.

(To be continued).

CONDITION OF THE WORKING CLASSES.

To the Editor of the Penny Mechanic and Chemist.

Sir,—As national improvement seems to be the leading topic of the day, I beg leave to offer a few observations upon the subject. That there are great numbers of the working population enduring great privations through want of employment, none, I apprehend, will attempt to deny; and yet there are thousands toiling from twelve to fifteen hours daily, and that for a very small pittance; and although, in some branches of labour, ten working hours is considered a day, the men are allowed to make from two to three days a week overtime; at the same time, and in the same branch, there are thousands starving for want of employment. Surely this is a national grievance, the removal of which would, in my opinion, be a very important step towards rational improvement. Now, sir, as machinery is making such rapid progress in this country, the time for labour ought to be universally reduced to eight hours per day. If this plan were uniformly adopted, the benefit of machinery would be generally felt, and all would be able to find employment. Hoping this subject may be taken up by an abler pen,

I remain, yours &c.,

An Unemployed Operative.

MISCELLANEA.

Extraordinary Excavator.—"Yankee Geologist."—The following is a description of the wonderful machine called the "Yankee Geologist," which has recently obtained great celebrity in the United States. "We paid a flying visit on Saturday last to Otis' steam excavator, in Brooklyn, where it is at work digging down the hill, formerly known as Fort Green, and filling up the shallow inlet and quagmire, entitled the Wallabout, or so much of it as lies above the old road to Flushing. The 'Yankee Geologist' is surely a great curiosity. He walks right into a mountain as though it were a plate of hot cakes, and dips up a cartload at a shovelful, as fast as you please. He cuts right and left a path some six rods wide through the hill, and then takes a new swath. He is locomotive, and advances by his own steam power, whenever the earth has receded before him, grades and takes down for himself, and only requires one man to shovel and another to look after the fire and engine, though one or two others are generally required to smooth the track before him, &c, besides tending the carts, which approach to be filled on one rail track, and go off loaded by another. If he comes to a stone weighing only a ton or such a matter, the 'Geologist' 'makes no bones' of it, but pitches it into the cart like a peck of gravel; if he comes to a stone weighing some four or five tons, he takes him up more carefully, and lays him out on the other side of his path. All this is effected by an immense shovel with a sliding bottom, at the end of an immense and complicated arm, worked by much ingenious and novel machinery. The inventor is now dead. The company have spent 30,000 dollars upon the invention, before the first machine was made, and much more afterwards. The patent, which is now secured throughout Europe, is probably worth 1,000,000 dollars. An excavator complete costs about 6000 dollars, and will dig and load 1000 cubic yards of earth per day—equal to the labour of 150 men—cares nothing for cold or heat, rain or fair weather, but goes a-head and minds its own business through all."—*Mining Journal.*

Trial of the Great Northern Archimedian Steam Ship.—By the first, and, necessarily, most imperfect trial of the *Great Northern's* capacity for performing the functions for which she was designed, we think we have reason to foretell the total disuse of paddles, and their ugly and cumbersome accompaniments — paddle-boxes.

The *Archimedes* screw is not seen outside the vessel while proceeding on her voyage, and its motion produces scarcely a ripple on the surface of the water. The vessel is shot forward at once, as if by a push from the shore; and, except that a funnel is seen (which very immaterially detracts from the beauty of the structure), no ignorant person could tell but that she was towed along by some invisible agency. While going over the flats, the *Great Northern* was proceeding at a rate of seven knots an hour (by Massey's patent log, which was used on the occasion), under the combined disadvantages of dangerously shallow water, and new, and, consequently, stiff machinery; but she was sailing eight knots (or upwards of ten miles) per hour, previously to her anchor being dropped in deep water; and it is only just to infer, that she will yet sail at the rate of nine, and, perhaps, ten knots an hour; as at no time during this trip did the screw make more than fifteen revolutions per minute, out of the twenty-two which it is calculated to make, only two-thirds of the proper steam power being applied. The "slip" was only one mile in seven—that is to say, though the screw revolved with supposed velocity, sufficient to send the vessel seven miles in a given time, the distance passed was but six miles. We understand that this description of loss is very considerably greater in the paddle system, amounting to four miles out of every ten. Of course, when the *Great Northern's* machinery is in proper working order, the "slip" will be so inconsiderable as to be not worth noticing. Never did a vessel obey the helm with more promptness; and it was a common remark on board, that a child might steer her. In short, the success of the experiment has been triumphant. In the lough the *Great Northern* has all the appearance of a frigate of the first class, and, as a mere sailing vessel, it is confidently expected that no frigate will beat her. In this sense she may be regarded as the finest steamer ever yet built; for no other vessel has as yet combined the power of steam propulsion with the strength, beauty, and fleetness of a man-of-war. On the whole, Derry has reason to be proud of sending from her port, such a magnificent specimen of naval architecture; and her builder, Captain Coppin, is well worthy of all the credit and patronage which can be bestowed upon him.

Great Consumption of Cast Iron.—In consequence of the intended junction of the Liverpool and Manchester with the Leeds and Manchester Railway, at Hunt's Bank, about 200 or 250 yards will have to be executed by the Bolton Railway Company. It will be formed entirely of cast iron, and will be elevated some eighteen feet above the level of the street; to effect which, fifty-one immense cast-metal beams will be required, each weighing about seven tons, and a similar number of pillars, each weighing five tons. Besides this, the entire length and breadth of the road will have a complete cast-metal flooring. The estimated weight of the whole is 1030 tons, exclusive of the wrought iron and the rails. The railway will be formed in the centre of the street, leaving a carriage road on each side. The design is beautiful, and the work, judging from appearances, will be of the most substantial description.—*Manchester Guardian.*

Royal Polytechnic Institution.—We were admitted yesterday evening to a private view of the most powerful apparatus of its kind in existence—a new microscope, constructed by Mr. Cary, the optician, for this Institution. The effects are produced by the agency of the oxyhydrogen jet playing on a piece of quicklime, familiarly known as the Drummond light, and are perfectly astounding, as the following accurate statement of facts will show:—The microscope in question consists of six powers, ranging from 130 times to 74,000,000 times. The second magnifying power magnifies the wings of the locust to twenty-seven feet in length. The fourth power magnifies the sting of the bee twenty-seven feet. By the sixth power, the eye of the fly, which is said to contain 750 lenses, is so magnified, that each lens appears to be fourteen inches in diameter; the human hair is magnified eighteen inches in diameter, or four feet in circumference. Nothing can exceed the beauty with which insect architecture is developed under the influence of this enormous power. The condensing lens is nine inches and a half in diameter.—*Times.*

INSTITUTIONS.

LECTURES DURING THE WEEK.

Westminster Literary and Scientific Institution, 6 and 7, Great Smith Street.—Thursday, December 22, George Pilcher, Esq., on Animal Mechanics. At half-past eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, December 19, T. Williams, Esq., M.B., on the Mental and Physical Characteristics of the various Races of Mankind. At a quarter-past eight o'clock.

QUERIES.

How to secure the two ends of the copper wire firm on to the steel centre wire, without altering the temper of the steel? For, as they are made at present, they become loose, and jar when struck by the hammer of a pianoforte. I have tried to fasten them with a tin-plate worker's iron, but the solder will not unite with the steel wire, and the blow-pipe softens the steel so much, that they break in pulling up to pitch, as each string has to bear a pull equal to seventy pounds before it is in tune. T. W.

What will stop the canker mould in books, and how to take out the moulds already formed? Is there in England an agent for the sale of the Philadelphia horoscope, and what is its price, &c.? N. N.

Glass being a non-conductor of heat, or, at most a very bad one, the thought struck me that, if the bars. back, and sides, of a fire-grate, were made of glass, there would be a greater degree of heat in the fire, than when surrounded, as now, with metal bars, back, &c., which, being good conductors of heat, actually draw a great deal from the fire, to produce an equilibrium. I am aware that, when a thin piece of glass is put into the fire, it will melt and run; but if a thick piece be placed in a fire, it will not, unless there is a greater degree of heat than usual. Supposing the back of a fire-grate to be made of a tolerably thick block of glass—say six inches, and the sides to correspond, the bars as thick, or thicker than those now in use, I do not think a common fire would melt them, but throw out a greater degree of heat by being concentrated, than when spread over so large a surface as at present. Perhaps some of your correspondents can inform me of the degree of heat necessary to melt glass in bars, and likewise iron in bars? H. S.

How is the composition made and applied on the small wax-tapers for sealing letters; for I find that gum alone with the composition does not answer, and without it the stuff rubs off? Where are scratch brushes to be had, as there is not one in any brush-makers in town? T. W. R.

ANSWERS TO QUERIES.

Cheap Electrical Discharging Rod.—It is not generally known, that the glass handles are quite unnecessary, as a common piece of wire answers just as well. I have often discharged a highly-charged jar with a pair of common scissors, holding them as in the act of cutting. W. H.

"W. T." To understand voltaic excitement, we must attend to the connexion made by slips of metal, from the copper of one pair to the zinc of the next. It is obvious, that if the zinc and copper, in one cell, acquired opposite electricities, a restoration would take place through the fluid; but, as metal connectors are better conductors than the fluid, so the difference of the excited electricity is conveyed, by the metal slip, from the copper to the next zinc. By this means the next fluid oxydates the zinc more rapidly, and more hydrogen is detached to the second copper. This, again, is connected with the third zinc by a metal slip, which renders the next zinc more oxydable, by the difference between what is carried back by the liquid, and forward by the metal. J. M.

"G. Starkey" begs to inform "J. B. F.", that the line is fixed to the point D, as shown in fig. 3 of my communication. If "J. B. F." will carefully peruse the subject again, he will find it distinctly stated in column 3, line 19, that D is the line holder.

G. Starkey.

"R. S. N." is informed, that he can prepare iodide of nitrogen as follows:—Pour a solution of ammonia upon a small quantity of powdered iodine; the iodide of nitrogen will then be precipitated in the form of a black powder, which may be collected by filtering the liquid: the black powder must then be dried gradually without heat. The above compound is very dangerous, as it explodes by the slightest heat or friction.

"A. C. S." may procure metallic antimony from its sulphuret, in the following manner:—Mix the sulphuret of antimony in powder, with two-thirds its quantity of cream of tartar, and pour it by spoonfuls into a red-hot crucible; then keep it at a red heat for a short time; the metallic antimony will then be found at the bottom of the crucible in the form of a button, which is sufficiently pure for most purposes. H. Dempsey.

TO CORRESPONDENTS.

J. Knox.—*Iceland spar, the substance which produces double images, consists of* 56 *lime, and* 44 *carbonic acid, with a specific gravity of* 2.714. *The faces are parallel, and inclined* 105° 5′, *but even and polished, splitting always on the face. From this cause it produces a double image, a direct one, and another, which is the result of all the reflections from all the surfaces, which, being regular, produce a definite effect.*

W. O.—*Concave burning mirrors have been made of great size and power. One of four feet diameter, made of copper and tin, melted iron ore in twenty-four seconds, a sixpence in seven seconds and a half, a halfpenny in twenty seconds, tin in three seconds. Water boils immediately and evaporates, wood flames in a moment, pumice-stone becomes glass, and earth yellow or green glass.*

Experimentalist.—*We really do not know how to advise him. If he wishes to make the article public, the only plan we can suggest is, to introduce it to some druggist in his own town, who may, perhaps, put him in the way of disposing of the article.*

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

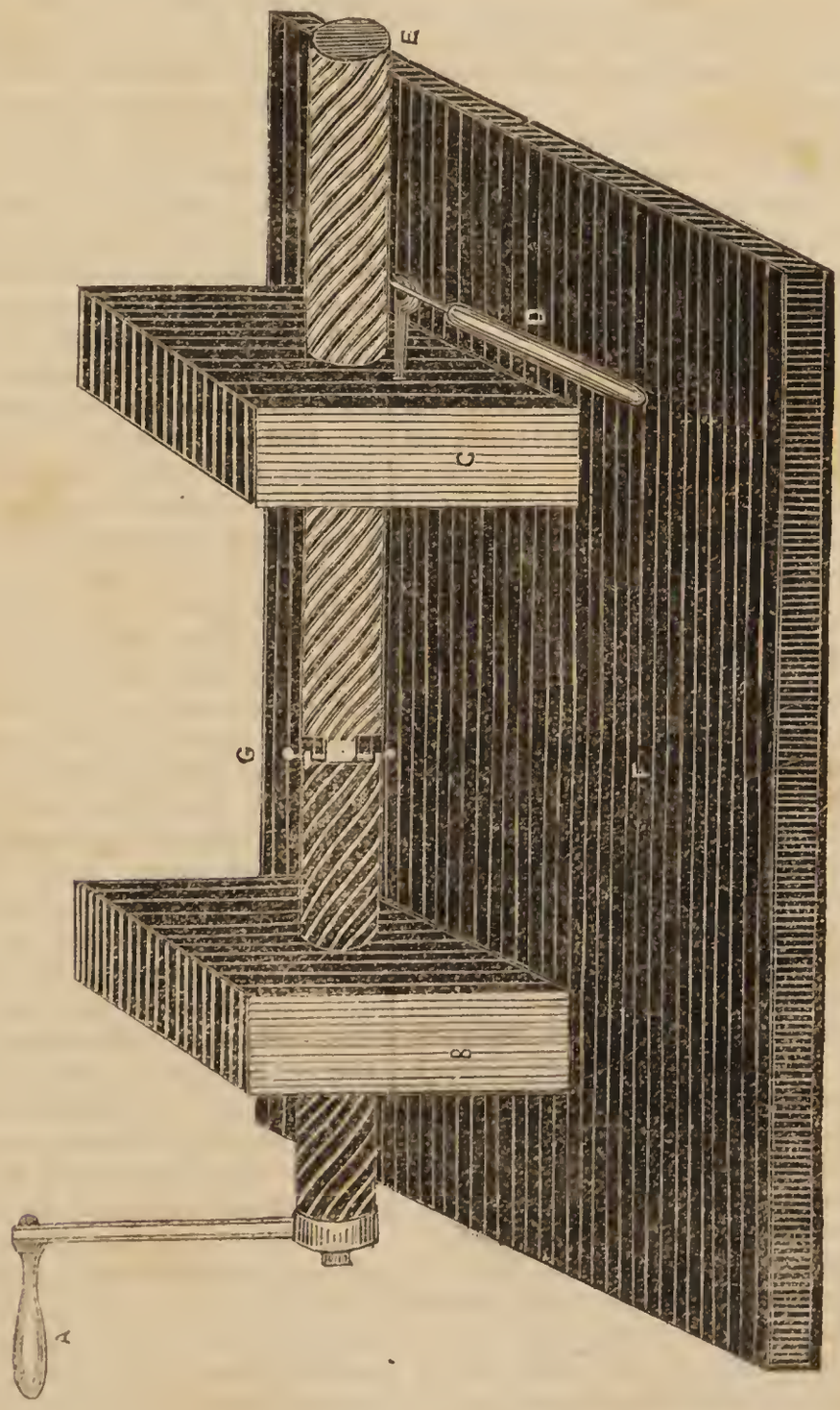
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. **115**, THIRD SERIES. | SATURDAY, DEC. 24, 1842. | No. 363, OLD SERIES.

APPARATUS FOR MAKING THE ELIZABETHIAN TWIST.



Vol. VIII.—No. 56.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

APPARATUS FOR MAKING THE ELIZABETHIAN TWIST.

(See Engravings, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—If you think the following description of a cheap and easy way of making the Elizabethian twist, be worthy a place in your excellent Magazine, it is at your service, and, I doubt not, will prove acceptable to your readers.

I am, sir, yours, &c.,
An Amateur Mechanic.

Description of the Engraving.

A, a handle turned by a boy backwards and forwards, until the work is finished.

B, a puppet tapped, the coil one inch and a half asunder.

C, a puppet with a hole in it the diameter of the mouth to be operated upon.

D, a tool, showing it on the rest or notch where it is held.

From E to G is the work in progress; also a nut or screw to fasten the work to at G.

F, a stand; the piece must first be turned to the size of the twist, if the work be four inches diameter, or the third must be four inches asunder.

MANUFACTURE OF GUN-BARRELS.

(Continued from page 436.)

The cause to which too great a recoil in muskets has been usually attributed, is the placing of the touch-hole at some distance from the breech-plug, so that the powder is fired about the middle, or towards its fore part, rather than at its base. To avoid this, some artists form a groove or channel in the breech-plug, as deep as in the second or third turn of the screw; the touch-hole opening into this channel, and thus firing the powder at its very lowest part. It appears, however, from a number of experiments made upon this subject by M. Le Clure, gunsmith to the King of France, that it made very little difference with regard to the recoil, whether the touch-hole was close to the breech, or an inch distant from it. The only circumstance to be attended to with respect to its situation, therefore, is, that it be not quite close to the breech-plug, as, in such a case, it is found to be more apt to be choked up, than when placed about a quarter of an inch from it.

The only other circumstance now to be determined with regard to musket barrels, is their proper length. Formerly it was supposed, that the longer they were made, the greater would be the distance to which they carried the shot, and that without any limitation. This opinion continued to prevail till about half a century ago, when it was first proposed as a doubt, whether long barrels carried farther than short ones. With regard to cannons, indeed, it had long before this time been known that they had been made too long; and Balthazer Killer, a celebrated cannon founder in the reign of Louis XIV., was able to account for it. When asked by Mons. Sorery de St. Nemy, why the colverin of Noney, which is twenty-two feet long, did not carry a ball equally far with a shorter piece? he replied, that the powder, when inflamed, ought to quit the cavity of the piece in a certain time, in order to exert its whole force upon the bullet; by a longer stay, part of the force is lost, and the same cause may produce an inequality in the shots, by giving a variation to the bullet, so as to destroy its rectilineal course, and throw it to one side or other of the mark. Mr. Robins, who on this, as well as every other question in gunnery, has almost exhausted the subject, informs us, that if a musket barrel of the common length and bore, be fired with a common leaden bullet and half its weight of powder, and if the same barrel be afterwards shortened one half, and fired with the same charge, the velocity of the bullet in this shortened barrel, will be about one-sixth less than what it was when the barrel was entire; and if, instead of shortening the barrel, it be increased to twice its usual length, when it will be near eight feet long, the velocity of the bullet will not hereby be augmented more than one-eighth part. And the greater the length of the barrel is in proportion to the diameter of the bullet, and the smaller the quantity of powder, the more inconsiderable will these alterations of velocity be. From these considerations, it appears that the advantages gained by long barrels are by no means equivalent to the disadvantages arising from the weight and incumbrance of using them; and from a multitude of experiments it is now apparent, that every one may choose what length he pleases, without any sensible detriment to the range of his piece. The most approved lengths are from thirty-two to thirty-eight inches. An opinion has generally prevailed among sportsmen, that by some unknown manœuvre, the gunsmith is able to make a piece, loaded with small shot, throw the contents so close together, that even at the distance of forty or fifty paces,

the whole will be confined within the breadth of a hat. From such experiments as have been made on this subject, however, it appears that the closeness or wideness with which a piece throws its shot, is liable to innumerable variations from causes which no skill in the gunsmith can possibly reach. So variable are these causes, that there is no possibility of making the same piece throw its shot equally close twice successively. In general, however, the closer the wadding is, the better disposed the shot seems to be to fall within a small compass. The closeness of the shot, therefore, would seem to depend in a great measure on preventing the flame of the powder from insinuating itself among its particles; whence the following method is said to be practised with success by those who shoot for a wager at a mark with small shot—viz. to put in the shot by small quantities at a time, ramming down a little tow or thin paper over each, so as to fill the interstices of the grains, and thus prevent the flames from getting in amongst the grains and scattering them. In firing with small shot, a curious circumstance sometimes occurs—viz. that the grains, instead of being equally distributed over the space they strike, are thrown in clusters of ten, twelve, sixteen, or more, whilst several considerable spaces are left without a grain in them. Sometimes one-third or one-half of the charge will be collected into a cluster of this kind; nay, sometimes, though much more rarely, the whole charge will be collected into one mass, so as to pierce a board near an inch thick, at the distance of forty or forty-five paces. Small barrels are said to be more liable to this clustering than large ones; and M. de Mordu informs us, that this is especially the case when the barrels are new, and, likewise, when they are fresh-washed, though he acknowledges that it did not always happen with the barrels he employed, even after they were washed. It is, probable, therefore, that the closeness of the shot depends on some circumstances relative to the wadding, rather than the mechanism of the barrel. Some pieces are composed of two or more barrels joined together; in which case, the thickness of each of the barrels is somewhat less than single-barrelled pieces. After being properly dressed, each of them is filed flat on the side where they are to join each other, so that they may sit more closely together. Two corresponding notches are then made at the muzzle and breech of each barrel, and into these are fitted two small pieces of iron, to hold them more strongly together. Being then united by tinning the contiguous parts, a triangular piece of iron, called the rib, is fastened on in like manner, running the whole length on the upper side, which serves to hold them more strongly together. After this they are to be polished and coloured in the manner described for single barrels. Great care should be taken that the barrels joined in this manner should be quite equal in strength to one another, and that both should be quite upright, or of an equal thickness throughout. If any inequality takes place in the strength of the barrels, the weaker will be warped by the action of the stronger; and the warping from this cause has sometimes been so considerable, as to render one of the barrels useless. To bring every part of the circumference of each barrel to an equal strength as nearly as possible, so that no part may be strained by the explosion, the part where they touch each other must be so reduced, that the partition between the two calibres be no thicker than either barrel was at the same place before it was filed, to join in this manner. Formerly, the double-barrelled pieces were made with one barrel lying over the other, each barrel having a separate hammer, and hammer spring, but only one cock for both. The barrels were, therefore, made to turn round at the place where the breeches joined with the stock; so that as soon as one was fired off, the other should be brought into its place by pressing a spring, moved by the guard with the right hand, while, with the left, the barrels were turned upon their common axis; and as soon as the charged barrel was thus brought into its proper situation, the spring descended into a notch and kept it firm. But this method was found to be too complicated and embarrassed, though, upon the same plan, three and four barrels were sometimes mounted upon one stock; but these pieces were intolerably heavy, and have no real superiority over the double-barrelled pieces which do not turn round, and which, of consequence, are now only made use of in forging barrels of all kinds. It is of considerable importance to have them made at first as near as possible to the weight intended when they are finished, so that very little be taken away by the boring and filing; for as the outer surface, by having undergone the action of the hammer more immediately than any other part, is rendered the most compact and pure, we should be careful to remove as little of it as possible, and the same holds good in a less degree with the inside,

which is to be cut with the borer. Pistol barrels are forged in one piece, two at a time, joined by their muzzles, and are bored before they are cut asunder, by which process there is not only a saving of time and labour, but a greater certainty of the bore being the same in both.

METHOD OF PAINTING IN ENAMEL.

(Continued from page 437.)

Most enamelled works are wrought at the fire of a lamp, in which, instead of oil, they put melted horse grease, which they call caballine oil. The lamp, which is of copper or white iron, consists of two pieces, in one of which is a kind of oval plate, six inches long and two inches high, in which they put the oil and the cotton. The other part, called the box, in which the lamp is melted, serves only to receive the oil which boils over by the force of the fire. This lamp, or where several artists work together, two or three more lamps are placed on a table of proper height. Under the table, about the middle of its height, is a double pair of organ-bellows, which one of the workmen moves up and down with his foot, to quicken the flame of the lamps, which are by this means excited to an incredible degree of vehemence. Grooves made with a gauge in the upper part of the table, and covered with parchment, convey the wind of the bellows to a pipe of glass before each lamp, and, that the enameller may not be incommoded with the heat of the lamp, every pipe is covered at six inches distance, with a tin plate fixed into the table by a wooden handle. When the works do not require a long blast, they only use a glass pipe, which they blow with their mouth. It is incredible to what a degree of fineness and delicacy, the threads of enamel may be drawn at the lamp. Those which are used in making false tufts of feathers, are so fine, that they may be wound on the reel like silk or thread. The fictitious jets of all colours used in embroideries, are also made of enamel; and that with so much art, that every small piece hath its hole to pass the thread through, wherewith it is sewed. These holes are made by blowing them into long pieces, which they afterwards cut with a proper tool. It is seldom that the Venetian or Dutch enamels are used alone; they commonly melt them in an iron ladle, with an equal part of glass or crystal, and when the two matters are in perfect fusion, they draw it out into threads of different sizes, according to the nature of the work. They take it out of the ladle while liquid, with two pieces of broken tobacco-pipes, which they extend from each other at arms' length. If the thread is required still longer, then another workman holds one end and continues to draw it out, while the first holds the enamel to the flame. Those threads, when cold, are cut into what lengths the workmen thinks fit, but commonly from ten to twelve inches; and, as they are all round, if they are required to be flat, they must be drawn through a pair of pinchers while yet hot. They have also another iron instrument, in form of a pincher, to draw out the enamel by the lamp, when it is to be worked and disposed in figures. Lastly, they have glass tubes of various sizes, serving to blow the enamel into various figures, and preserve the necessary vacancies therein, as also to spare the stuff and form the contours. When the enameller is at work, he sits before the lamp, with his foot on the step that moves on the bellows, and holding in his left hand the work to be enamelled on the brass or iron wires the figures are to be formed on, he directs with his right the enamel thread which he holds to the flame, with a management and patience equally surprising. There are a few things they cannot make or represent with enamel; and some figures are as well finished as if done by the most skilful carvers.

COAL-GAS.

The Drummond Light, the Gurney or Bude Light, and the Boccius Light, exclusive of the "Light of all Nations," are the great lights of the age. The first is the oxy hydrogen, the union of oxygen and hydrogen gas on lime, and at a very high temperature. The second is the oxy-oil, a jet of oxygen being introduced by means of a very peculiarly-shaped conical jet into the centre of an ordinary oil-wick flame. This was perfected, we believe, under the auspices of the Trinity Board, having been intended to be used in light-houses; and we have heard it designated to that view by a high authority, as an arrangement affording the greatest possible amount of light in the smallest possible space. The third is a coal gas light; and of this we make the chief mention. This light, of course, is no recent discovery—it was known so long ago as 1688; but, since then, what an increase of knowledge of the properties of coal-gas has been gained, and what great mechanical improvements have been arranged for its

combustion! Of the latter character is the Boccius light, or, perhaps, more correctly speaking, the Boccius gas-lamp. The one set up opposite Northumberland House, crowned with ugliness, consists of three ring-burners, large, lesser, and less, perforated so thickly with holes, that the flames form, as it were, three leaves of light; these are protected from the lateral currents of air by a glass screen, and are thrown down and around by a metallic reflector. The illuminating power is very considerable. Contemplating the vast establishments in the present day, for the manufacture of coal-gas; the numerous improvements for its thorough combustion, mechanical and chemical, of the latter especially—Low's Naphthalised gas, the perfection of artificial light—we cannot help reverting to the extent of the knowledge of gas and its properties, as mentioned in a letter addressed to the Royal Society, May 12, 1688, by Mr. John Clayton, rector of Crofson, at Wakefield, in Yorkshire, and contrasting the bladders of 1688 with the gasometers of 1842. Speaking of the thunder in Virginia, and its dreadful effects, the writer says, "I have been told by very serious planters that, thirty or forty years ago, when the country was not so open as now, the thunder was more fierce; and that sometimes, after violent thunder and rains, the roads would seem to have perfect casts of brimstone; and it is frequent, after much thunder and lightning, for the air to have a perfect sulphureous smell. Durst I offer my weak reasons when I write to so great masters thereof (meaning the council of the Society), I should here consider the nature of thunder, and compare it with some sulphureous spirits which I have drawn from coals that I could no way condense, yet were inflammable; nay, would burn after they passed through water, and that seemingly fiercer, if they were not overpowered therewith. I have kept some of this spirit a considerable time in bladders; and though it appeared as if it were only blown with air, yet if I let it forth, and fired it with a match or candle, it would continue burning until all were spent."

Properties of Coal.—Compounds of carbon, hydrogen, &c., form various coals; thus, Newcastle coals are 75 carbon, 4.2 hydrogen, 16 azote, 4.8 oxygen. Soft coal is 74 carbon, 13 hydrogen, 10 azote, and 3 oxygen; and cannel is 65 carbon, 22 hydrogen, and 11 azote.

USES OF THE ALKALIMETER.

(Continued from page 438.)

Great variations are met with in some parts of these articles; in the pearlashes and potashes, for instances, by the fraudulent mixture of various foreign salts, the alkaline part of which, neutralized by the sulphuric and muriatic acids, is of no use to soap-makers, dyers, and bleachers. We meet with variations also in the sodas, by means of the addition of herbs, other than the salsola and the salicornia at the time of incineration; or also in sodas, produced by the combustion of plants before their maturity. For, according to Chaptal, the latter is almost entirely muriate without alteration. Certain potashes contain also sulphur and charcoal in solution. The casks and packages of the alkalies are not always of the same quality in their different points and various pieces. The two extremities of a cask, and its centre towards the bung, have been found to contain good potash: the other parts were of a very inferior quality, or contained nothing else than earth. Some unprincipled people have made a traffic of soda from sea wrack, which they sell in place of Alicant soda, giving it an exterior appearance by means of a process, which it would be useless, if not criminal, to divulge.

On the other hand, extraordinary degrees in point of strength are sometimes met with, such as pearlashes at 66°; American pearlashes of the first sort at 72°; and even these potashes, marked second sort, at 56°; and, lastly, pieces of natron at 60°. These last had probably been deprived of all water of crystallization.

Not only the consumer of the alkalies of commerce has hitherto only had very precarious methods of estimating comparatively the real pecuniary value of what he buys, but also that he is exposed to very troublesome inequalities in the result of his operations, if he employs, as almost always happens, the good and the bad commodities in equal doses. Whether a dyer, for instance, employs soda at 30° or at 15°, he will be equally exposed to fail in his operations, and, consequently, to experience great losses, either from his alkali being weaker or stronger than usual.

On extending these reflections, we see that all the arts which require the consumption of alkalies would be benefitted, if, on the one hand, potashes, sodas, and natron, were constantly homogeneous in the same cask, and bore a mark indicating their alkaline strength; and if, on the

other hand, we could announce in the prices current that such an alkali, of a certain alkalimetrical degree, costs so much the cwt. We may conceive, in fact, what advantage a dealer in this article would have over his neighbours, who could say to his customers—"I offer you graduated potash, graduated soda, graduated salt of soda, and graduated natron, at such and such prices and alkalimetrical degrees. You have now in your possession an instrument with which you may, without chemical knowledge and without calculations, try, or cause to be tried, under your own inspection, 100 specimens in a day, and thus verify the qualities I announce to you in my prices current, and which are marked upon my packages." It cannot be doubted, that the merchant who could deal in this manner would obtain a great preference, and, ultimately, others would be induced to pursue the same course. We shall now proceed to the details of the processes of which he may avail himself.

Suppose we have 100 casks of potash, containing about 400 kilogrammes each: we may give all of them the same alkaline strength, and may afterwards ascertain it, and point it out in a precise manner.

Each of the casks is opened at one end, and the potash it contains is emptied upon the ground. We must afterwards break, with a long-handled mallet, all the masses which are larger than a large nut; the whole must then be mixed equally, which may be done in five minutes by two men furnished with wooden shovels. The potash must be afterwards replaced in the casks, arranging the business so that the casks, whether full or not, shall contain the same number of pailfuls or measures. All these casks having been thus opened, their contents broken and mixed up, a common mixture may be once more made of all their contents.

For this purpose, a place being set apart on the floor of the store-room, we must bring, one after another, a pailful of the potash from each barrel alternately; a sufficient number of men being furnished with wooden shovels, the whole mass may be mixed up as exactly as possible. The casks are afterwards filled; and by this means we may ascertain that their contents have an equal degree of alkaline strength, which may be proved by a single trial.

The trial must be done with exactitude, and in the following manner:—We must put about two kilogrammes of the general mixture into a mortar, and pound them until no piece remains larger than a grain of wheat. One decigramme must then be weighed exactly, which, upon being subjected to the proof by the alkalimeter, will indicate the alkaline strength of the whole potash in the casks.

It is easy to prevent any loss of weight in any of the casks, by care and celerity in the manipulation; during which, in damp seasons, a stove should be placed in the store-room. If this precaution is not adopted, there will be an increase of weight.

It will not be difficult to apply these manipulations to soda. This article must be first broken by means of a piece of iron, then pounded in mortars, or bruised under a vertical mill, the stamper of which is inserted in a wooden axis: the soda in powder must then be passed through a metallic sieve for the convenience of those who use it. As soon as the quantity is procured, requisite to fill a given number of casks, we must then proceed to make the general mixture above described, and pursue the usual method, with the peculiar modifications applicable to the trials upon soda.

As to natron, the same method may be adapted as with potash, with this exception, that the masses being generally larger and harder, they require a little more time and manipulation than potash.

Some people may be apprehensive that the expense of these manipulations would counterbalance the advantages to be derived from them; but, upon trial, it will be found that objections of this nature, from the simplicity of the operations required, have not the weight that may be imagined.

To the Editor of the Penny Mechanic and Chemist.

SIR,—In No. 111 of your valuable Magazine, "A Foreigner" has given a description of some newly-invented boots, called the "acceleropœdo;" I shall consider it a favour if he or some other correspondent will inform me what the metal springs are made of, and how they are placed between the soles; and, also, what the chemical article is composed of, which gives them such a delightful feel to the wearer?

I remain, yours, &c.,

O. M.

MISCELLANEA.

The "Family Herald."—This is the title of a cheap literary publication, just issued, composed by females, at a newly-invented "composing-machine," in shape

resembling a cottage-piano. The paper, which is neatly printed, is stated to have been set-up by two young females, in the same space of time as would have required the exertion of five skilled hands by the ordinary method." The inventor expresses his opinion that, from the facilities which it will afford for cheap printing, it will, like other inventions, tend to increase, rather than to decrease, the demand for manual labour.

Silk and Stuff Hats.—A writer in the *Chemist*, of this month, states that silk hats are extremely prejudicial to the growth and preservation of the hair, inasmuch as they are made in such a manner as to be air-tight, and thus to prevent the escape of the insensible perspiration from the head. The writer says, "Men who constantly wear silk hats lose their hair much sooner than those who adhere to the use of beaver; and this will explain to many, who have not been before able to account for it, the reason of their becoming prematurely bald, and not unfrequently experiencing unpleasant sensations about the head. The fact, that those who wear silk hats become bald earlier than others, is well known to every one in the hat trade. A traveller for a large firm has been heard to say, that he would eat every hair left on the head of a man who had worn a silk hat for ten years; meaning, of course, that such a person would be completely bald." The use of beaver hats is accordingly recommended, as very superior to those made of silk.

New Primer for a Musket.—A new primer for a musket, recently invented by Mr. Westley Richards, the well-known gun-maker, of Birmingham, has undergone a most effectual trial on board the *Excellent*, for the last three months; and as Sir Thomas Hastings has recommended the Board of Admiralty to adopt it for the use of the navy, we should hope that this simple and ingenious invention will be secured to the Government. The following is a description of it:—The primer, which is intended to supersede the copper cap, is of a very novel character, being made of *papier machee* or mill-board, and perfectly secured from damp or wet in its process of manufacture. It is one inch in length, half-an-inch wide, and the sixteenth of an inch in thickness, the form being slightly wedge shape. The application to the gun is most readily applied into a touch-hole suitable to it, instead of the common cone or nipple; the priming powder is concealed in the centre of the primer, and covered with tin-foil. The gun is fired in the ordinary manner, and for military and naval use, it is decidedly superior to the copper cap, as, after the explosion, the primer is perfectly harmless; and on the deck of a ship, sailors without shoes, cannot be injured by laceration of the feet, which must inevitably be the case from an exploded copper cap when trod upon. Their cheapness and undecaying quality is also a great recommendation to them; at the same time, they are perfectly impervious to damp or wet.

The Great Metropolis.—London contains 100,000 houses of business, to one-half of which shops are attached. It consumes about 2,000,000 barrels of porter and ale, all brewed within its own limits; 1,403,466 sheep have been sold at Smithfield in one year, and 183,000 head of cattle. It imports from the Continent 70,000,000 of eggs, besides the millions that are produced at home; and 12,000 cows furnish it with a very inadequate supply of milk. Holland and Ireland are laid under contribution for its butter—the most distant seas and rivers for its fish. Its water companies supply it with 227,000,000 of hogsheads of water per year. Its gas companies produce about 10,000,000 cubic feet of gas every twenty-four hours, which feed 100,000 lights. Its paving costs annually at least 200,000*l.*—its sewer rates, double the amount. It has 6000 hotels, taverns, and coffee shops, and twenty theatres. Its newspapers consume nearly 30,000,000 stamps. Its steam-boats offer accommodation to 10,000 passengers daily, in pursuit of business or health. One thousand miles of railway already completed, at an expense of 47,000,000*l.*, and fifty-nine canals, in which capital to the amount of 14,500,000*l.* is embarked, link together the most distant parts of the island. With the Port of London are connected the East and West India Docks, the London Docks, the Commercial Docks, and the St. Katherine's Docks, affording altogether an amount of accommodation for shipping, without a parallel in the history of trade. West India Docks alone comprise about 295 acres, and can hold conveniently 500 large merchantmen. The London Docks cover 100 acres of ground, and the vaults beneath the warehouses contain cellarage for 65,000 pipes of wine. 68,671,000 letters passed through its Post-office in 1841. The monthly aggregate demands paid by the London bankers through the Clearing-house, average 75,000,000*l.* The accumulations of one Insurance Company alone (the Equitable), amount to nearly 13,000,000*l.*:—and this gigantic combi-

nation in London of every element of enterprise and wealth, coupled with the energy and experience of its merchants, and the unrivalled skill of its artisans, make it, in every sense, what even its rivals admit it to be—the commercial capital of the world.

South-Eastern (London and Dover) Railway.—Another portion of this undertaking (from Headcorn to Ashford) was opened on Monday. A special train started from London Bridge at nine o'clock, to convey the Government Inspector of Railroads, Major-General Pasley, and Mr. Lang, the legal adviser to the railway department of the Board of Trade, on their final tour of inspection. These gentlemen were accompanied by Mr. Cubitt, the engineer, and many of the directors and their guests. From Headcorn the line runs almost due east, through a flat but most charming portion of the Weald of Kent. The cuttings are few, and the embankments little more than the turning up of the sides to raise the road above the level of the neighbouring watercourses. The engineering difficulties in this portion, therefore, have been extremely slight, and, indeed, with the exception of the Belgian railroads, we do not know of any line on which the works for twenty miles have been lighter than from Maidstone Road to Ashford. The only feature of particular interest, is the wooden or Swiss bridges over some of the streams, which appear to be as strong for the passage of the train, as ordinary brick or stone work. Ashford is a charming spot, in the midst of green meadows, and surrounded by gentlemen's seats, embosomed in lofty elm trees.

INSTITUTIONS.

LECTURES DURING THE WEEK.

Westminster Literary and Scientific Institution 6 and 7, Great Smith Street.—Thursday, December 29, George Pilcher, Esq., on Animal Mechanics. At half-past eight o'clock.

Mutual Instruction Society, 16, Great Tower Street, City.—Monday, December 26, Quarterly Meeting. At a quarter-past eight o'clock.

QUERIES.

How to keep an equal velocity to different numbers of trains of wheel work. I have a train of nine wheels, to which I employ thirteen pounds propelling power, which gives me the required velocity. Now I wish to add one, two, and even three more wheels. I should feel obliged if any correspondent would inform me, what weighs should be added to give the same velocity to the addition of each wheel as I have at present?

J. W. E.

Can the Daguerreotype or photographic process be made available for a camera obscura for private amusement; if so, what are the minute details of the process? C. Y. K.

ANSWERS TO QUERIES.

It is stated in several works relating to the steam-engine, that the same volume of steam will always produce the same mechanical effects, whether it is admitted into a wide or narrow cylinder; providing, of course, that both cylinders are of the same capacity. I cannot exactly understand this, and shall be very much obliged if some one of your numerous and intelligent correspondents will give reasons why it is so. I have always had an idea, that the more moveable surface there was, the greater was the power of the engine; but I am no engineer. However, if the first statement is true, there can be no advantage in any of the two piston engines that have been invented, and, among others, none in the one sketched below. It is merely a fanciful

form, and has no framing drawn to it for the support of the engine; but the action will, I think, be apparent, on an inspection of the engraving. The dotted lines, c c, show where the connecting rods attach to the crank borne, and the crank in this engine is nearly two-thirds of the stroke, instead of half; B is a flange, cast into the cylinder, to which the framing may be fastened. Of course, either the crank or the slide rod, D, may set uppermost. I shall be glad if some of your readers would give a description of the much-talked of disc and trunk engines? QUESTIO.

"A. L. S." The specific gravity of palladium, 11800; tin, 7290; muriatic acid, 1160.

O. M.

London: Printed at "The City Press," 1, Long Lane, Aldersgate, by D. A. Doudney (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. Berger, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

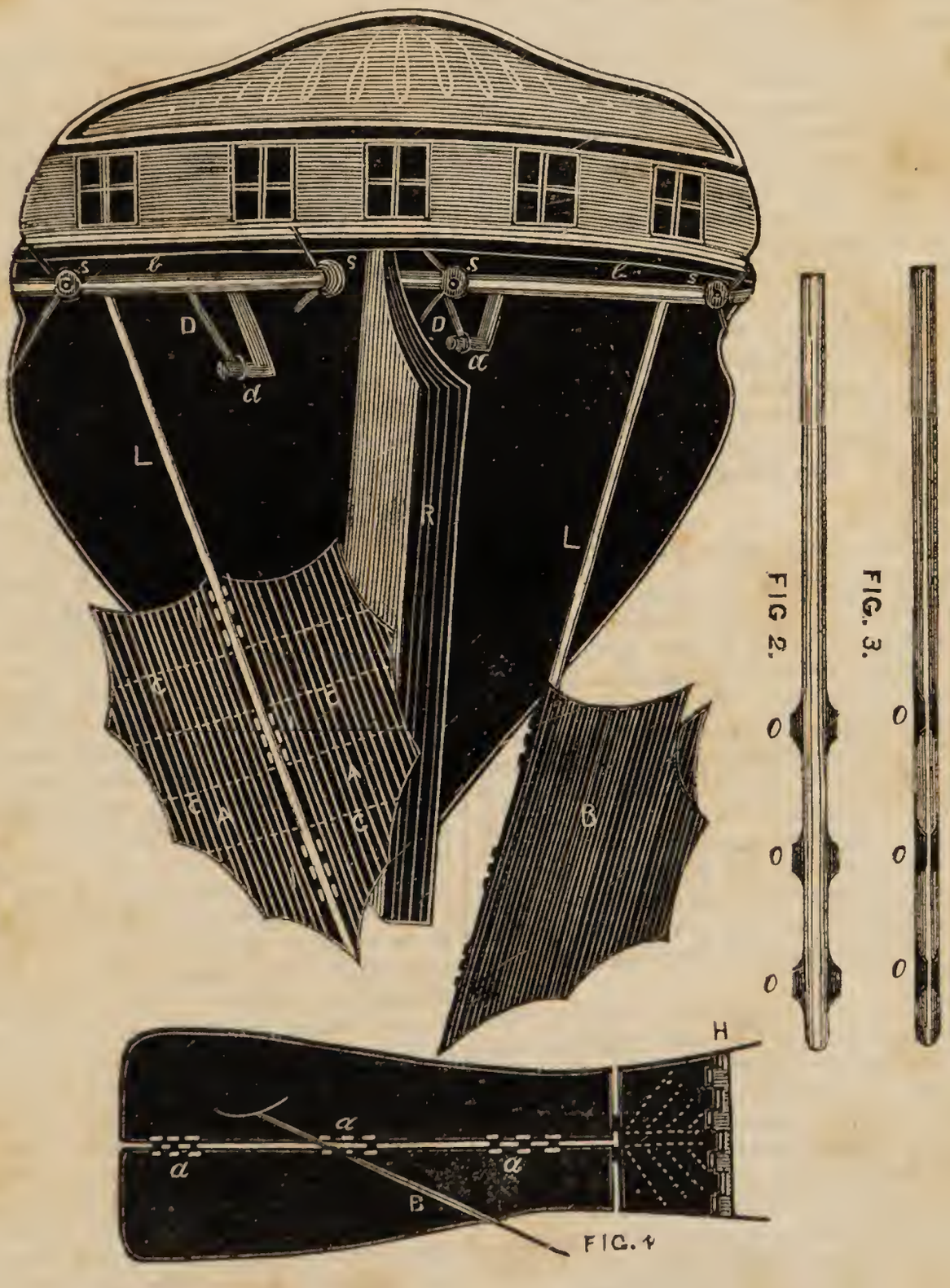
THE PENNY MECHANIC

AND CHEMIST.

A MAGAZINE OF THE ARTS AND SCIENCES.

No. **116**, THIRD SERIES. | SATURDAY, DEC. 31, 1842. | No. 364, OLD SERIES.

NISBET'S PLAN FOR PROPELLING STEAM-VESSELS.



Vol. VIII.—No. 57.] [City Press, 1, Long Lane, Aldersgate Street: D. A. Doudney.

NISBET'S PLAN FOR PROPELLING STEAM VESSELS.

(See Engraving, front page.)

To the Editor of the Penny Mechanic and Chemist.

Sir,—I have taken the liberty to send you the diagram of a plan for propelling steam vessels, which, if you think worthy a place in your Magazine, the insertion of it will oblige

Yours obediently,

M. T. Nisbet.

It appears, Sir, though there have been numerous plans invented and brought into practice for propelling steam-boats, few of them have realized the anticipation of the inventors or patrons. It is, indeed, a fact, that the improvements have been so trifling, that the old-fashioned wheel, with all its complicated faults, is allowed to supersede them; the cause of their repeated failures I attribute to their studying complicated machinery, instead of studying nature. In the plan I have sent you, I have attempted to copy from nature. Buffon tells us, that the penguins, having their paddles placed farther behind the moving body than other water-fowl, are the swiftest in the water; for this reason I have placed my paddles at the stern of the vessel, they being, likewise, more out of danger.

Description of the Engraving.

Fig. 1 represents the stern of the vessel; A, the paddle, expanded; B, the paddle collapsed; *h h h h*, the hinges; *a a*, two cranks or arms attached to the horizontal beams, *b b*, working in sockets, *s s s s*, and to which the paddles, A and B, are likewise attached, by means of the iron legs, L L; D D, two iron bars, working with two wheels (which I could not show in the drawing), which cause the arms, *a a*, to move backward and forward, forming a segment of a circle; *c c c c* are chains fastened to the periple of the paddles, to bear part of the strain; R, the rudder.

Figs. 2 and 3, the legs, L L; *c c c c* are iron bearers fixed to the paddles, and which press against each other, when the paddles are sufficiently expanded. See fig. 3, where the paddles are expanded, and fig. 2, where the paddles are collapsed.

Fig. 4 represents a fin or paddle, to give a retrograde motion to the vessel when the vessel is driven forward by the paddles, A and B. The paddles, fig. 4, lie close to the side of the vessel: there are two paddles, one for each side of the vessel; B, a bar, for giving motion to the paddle *a a a a*, hinges, to allow the paddle to collapse; H, the hinge, attached to the side of the vessel, and on which the paddle works. The machinery, which gives motion to the paddles, I have not shown, as I did not wish to trouble you with too many illustrations, but it is very simple; the paddles, A and B, work alternately, and are detached from each other, which will greatly facilitate the turning of the vessel; for instance, suppose the vessel has to turn to larboard, then give motion to the starboard paddle, and let the larboard hang motionless.

MANUFACTURE OF TAPESTRY.

Tapestry is distinguished by two kinds—high and low warp; but the difference is more in the manner of making, than in the work itself, which is, in effect, the same in both; only the looms, and, consequently, the warps, are differently situated; those of the low warp being placed flat and parallel to the horizon, and those of the high warp erected perpendicularly. Our own countrymen formerly excelled all the world in the tapestry of the high warp, and they still retain their reputation, but with some little change; these low warps are still admired; the high ones are quite laid aside by the French.

Tapestry of the high warp is manufactured in the following manner:—The loom on which it is wrought is placed perpendicularly; it consists of four principal pieces, two long plants, a cheek of wood, and two thick rollers or beams. The planks are set upright, and the beams across them; one at the top, and the other at the bottom, about a foot distance from the ground. They have each their trunnions, by which they are suspended on the plank, and are turned with bars. In each roller is a groove from one end to the other, capable of containing a long sound piece of wood, fastened therein with hooks. It is used to tie the ends of the warp to each other. The warp, which is a kind of worsted, or twisted woollen threads, is wound on the upper roller, and the work, as fast as wove, is wound on the lower. Withinside the planks, which are seven or eight feet high, fourteen or fifteen inches broad, and three or four feet thick, are holes pierced from top to bottom, in which are put thick pieces of iron, with hooks at one end, serving to sustain the coat stave; these pieces of iron have also holes pierced, by putting a pin in by which the stave is drawn nearer, or set farther off; and thus the coats or threads are

stretched or loosened at pleasure. The coat stave is about three inches diameter, and runs all the length of the loom; on this are fixed the coats or threads, which make the threads of the warp cross each other. It has much the same effect here as the spring stave and treddles have in the common looms. The coats are little threads fastened to each thread of the warp, with a kind of sliding knot, which forms a sort of mark or ring. They serve to keep the warp open for the passage of broaches, wound with silk woollens or other matters used in the piece of tapestry. In the last place, there are a number of little sticks of different lengths, but all about an inch in diameter, which the workman keeps by him in baskets to serve to make the thread of the warp cross each other, by passing them across; and that the threads thus crossed may retain their proper situation, a packthread is run among the threads above the stick.

The loom being thus formed and mounted with its warp, the first thing the workman does, is to draw on the threads of this warp the principal lines and strokes of the design to be represented on the piece of tapestry, which is done by applying cartoons made from the painting he intends to copy, to the side that is to be the wrong side of the piece, and then with a black-lead pencil, following strong out the cartoons thereof, on the thread of the right side, so that the strokes appear equally both before and behind. As for the original design, the work is to be finished by it; it is hung up behind the workmen, and wound on a long staff, from which a piece is unrolled from time to time, as the work proceeds.

Besides the loom, &c., here described, there are three other principal instruments required for working the silk or the wool within the threads of the warp; these are a brooch, a reed, and an iron needle. The brooch is made of a hard wood seven or eight inches long, and two-thirds of an inch thick, ending in a point with a little handle. This serves as a shuttle; the silks, woollen, gold or silver, to be used in the work being wound on it. The reed or comb is also of wood, eight or nine inches long, and an inch thick on the back, whence it grows less and less to the extremity of the teeth, which are more or less apart, according to the greater or less degree of fineness of the intended work. Lastly, the needle is made in form of a common needle, only bigger and longer. Its use is to press close the wool and silk, when there is any line or colour that does not fit well. All things being prepared for the work, and the workman ready to begin, he places himself on the wrong side of the piece, with his back toward the design, so that he works, as it were, blindfold, seeing nothing of what he does, and being obliged to quit his post, and go to the other side of the loom, whenever he would view and examine the piece, to correct it with his pressing-needle.

To put silk, &c, in the warp, he first turns and looks at the design, then taking a brooch full of the proper colour, he places it among the threads of the warp, which he brings across each other with his fingers, by means of the coats or threads fastened to the staff; this he repeats every time he is to change his colour. Having placed the silk or wool, he beats it with his reed or comb, and when he has thus wrought in several rows over each other, he goes to see the effect they have, in order to reform the contour with his needle, if there be occasion. As the work advances, it is rolled upon the lower beam, and they unroll as much warp from the upper beam, as suffices them to continue the piece: they do the same with the design behind them. When the pieces are wide, several workmen are employed at one time.

The high warp tapestry goes on much more slowly than the low warp, and takes nearly thrice the time and trouble; but all the difference that the eye can perceive between the two kinds, consists in this, that in the low warp there is a red fillet, about one-twelfth of an inch broad, running on each side, from top to bottom, which is wanting in the high warp.

In the manufacture of tapestry of the low warp, the loom or frame on which it is wrought, is much like that of the weaver; the principle thereof are two strong pieces of wood, forming the side of the loom, and bearing a beam or roller at each end; they are sustained at the bottom with other strong pieces of wood, in manner of truffles, and, to keep them the firmer, they are likewise fastened to the floor with a kind of buttress, which prevents any shaking, though there are sometimes four or five workmen leaning on the fore beam at once. The rollers have each their trimmers, by which they are sustained; they are turned by large iron pins three feet long. Along each beam runs a groove, wherein is placed the wick, a piece of wood of about two inches diameter, and almost of the length of the roller; this piece fills the groove entirely and is fastened thereon from space to space by wooden pins. To the niches are fastened the two extremities of the warp

which is wound on the farther roller, and the work as it advances on the bearer.

Across the two sides, almost in the middle of the loom, passes a wooden bar, which sustains little pieces of wood, not unlike the beam of a balance. To these pieces are fastened strings, which bear certain spring staves, wherewith the workman, by means of two treddles under the loom, whereon he sets his feet, gives a motion to the coats, and makes the threads of the warp rise and fall alternately.

Each loom has more or less of these spring staves, and each staff more or less coats, as the tapestry consists of more or less threads. The design or painting, the tapestry man is to follow, is placed underneath the warp, where it is sustained from space to space with springs, by means of which the design is brought nearer the warp.

The loom being mounted, there are two instruments used in working it—viz. the reed and the flute. The flute does the office of the weaver's shuttle. It is made of a hard polished wood, three or four lines thick at the ends, and somewhat more in the middle, and three or four inches long. On it was bound the silks or other matters to be used, as the woof of the tapestry. The comb or reed is of wood or ivory; it has usually teeth on both sides; it is about an inch thick in the middle, but diminishes each way to the extremity of the teeth; it seems to beat the threads of the woof close to each other, as fast as the workman has passed and placed them with his flute amongst the threads of the warp. The workman is seated on a bench before the loom, with his breast against the beam, only a cushion or pillow between them, and in this posture separating with his fingers the threads of the warp, that he may see the design underneath; and, taking a flute mounted with a proper colour, he passes it amongst the threads, after having raised or lowered them by means of the treddles moving the spring staves and coats.

Lastly, to press and close the threads of the silk or yarn, &c., thus placed, he strikes each course—that is, what the flute leaves in its passing and coming back again—with the reed.

GOLD AND SILVER FILLAGREE.

There is no manufacture in any part of the world that has been more admired and celebrated, than the line gold and silver fillagree of Sumatra. And what renders it a matter of greater curiosity, is the coarseness of the tools employed in the workmanship, and which, in the hands of a European, would not be thought sufficiently perfect for the most ordinary purposes. They are rudely and inartificially formed by the goldsmith (pandi) from any old iron he can pick up. When you engage one of them to execute a piece of work, his first request is usually for a piece of iron hoop to make his wire-drawing instrument. An old hammer-head stuck in a block, serves for an anvil, and a pair of compasses, is often composed of two old nails tied together at one end. The gold is melted in a piece of an earthen rice-pot, or sometimes in a crucible of their own make of ordinary clay. In general they use no bellows, but blow the fire with their mouths through a point of bamboo; and if the quantity of metal to be melted is considerable, three or four persons sit round their furnace, which is an old broken quallie or iron pot, and blow together. At Padong alone, where the manufacture is more considerable, they have adopted the Chinese bellows. Their method of drawing the wire differs but little from that used by European workmen. When drawn to a sufficient fineness, they flatten it by beating it on their anvil, and, when flattened, they give it a twist, like that in the whalebone handle of a punch-ladle, by rubbing it on a block of wood with a flat stick. After twisting, they again beat it on the anvil, and by these means it becomes flat wire with indented edges; with a pair of nippers they fold down the end of the wire, and thus form a leaf or element of a flower in their work, which is cut off. The end is again folded and cut off, till they have got a sufficient number of leaves, which are laid on singly. Patterns of the flowers or foliage, in which there is not very much variety, are prepared on paper, of the size of the gold plate on which the fillagree is to be laid. According to this, they begin to dispose on the plate the larger compartments of the foliage, for which they use plain flat wire of a larger size, and fill them up with leaves before mentioned.

To fix the work, they employ a gelatinous substance, made of the red-hot berry called boca sago, ground to a pulp on a rough stone. This pulp they place on a young cocoa nut, about the size of a walnut, the top and bottom being cut off. After the leaves have been all placed in order, and stuck on bit by bit, a solder is prepared of gold filings and borax, moistened with water, which they strew over the plate, and then putting it in the fire for a short time, the whole becomes united.

This kind of work on a gold plate, they call corrong-papon. When the work is open, they call it corrong-troose. In executing the latter, the foliage is laid out on a cord or soft kind of wood, and stuck on as before described with the sago berry, and the work, when finished, being strewed over with their solder, is put into the fire, when the cord or soft wood burning away, the gold remains connected. If the piece be large, they solder it at several times. In the manufacture of badjoo buttons, they first make the lower part flat, and, having a mould formed of a piece of buffalo horn, indented to several sizes each, like one-half of a bullet mould, they lay their work over one of these holes, and, with a horn punch, they press it into the form of a button. After this, they complete the upper part. When the fillagree is finished, they cleanse it by boiling in water with common salt and alum, or sometimes lime juice, and, in order to give it that fine purple colour, which they call sapo, they boil it in water with brimstone. The manner of making the little balls with which their works are sometimes ornamented, is as follows:—They take a piece of charcoal, and, having cut it flat and smooth, they make it in a small hole, which they fill with gold dust, and this, melted in the fire, becomes a little ball. They are very inexpert at finishing and polishing the plain parts, hinges, screws, and the like, being in this as much excelled by the European artists, as these fall short of them in the fineness and minuteness of the foliage. The Chinese, also, make fillagree mostly of silver, which looks elegant, but wants, likewise, the extraordinary delicacy of the Malay work. The price of the workmanship depends upon the difficulty or uncommonness of the pattern; in some articles of usual demand, it does not exceed one-third of the value of the gold; but in matters of fancy, it is generally equal to it.

USES OF THE ALKALIMETER.

(Continued from page 438.)

Of all the acids combined with the alkalies, the carbonic acid is that which deprives them the least of their energy, and which may be taken from them with most facility: it is by means of lime that, from time immemorial, the effect has been produced upon which several chemical arts have been founded, and particularly that of the soap-makers; but as the existence of carbonic acid was scarcely known formerly, the art of combining it with lime, by taking it from the alkalies, is felt, even at the present time, as a consequence of the ancient imperfection of chemical knowledge. Although for more than five-and-twenty years the theory of the various carbonates seems to leave nothing more to be desired, we have not even yet any certain rules for the caustification of the alkalies by lime.

Experiments prove that the potash furnished by the combustion of all the vegetables, is a salt with excess of base, in which the proportions of carbonic acid and potash are constantly the same; so that 100 parts of sulphuric acid always displace by their saturation only forty parts of carbonic acid, when we employ any of the potashes of commerce; while, if we saturate these same 100 parts of sulphuric acid by truly neutral carbonate of potash, we constantly displace 84 parts of carbonate acid. We know that heat takes from the carbonate of potash only a portion of its acid; it is therefore probable that this quantity of carbonate acid remaining in the potash of commerce is constant, which even the heat of incineration cannot diminish; and likewise that, after having exposed carbonate of potash to this degree of heat, we shall find that it has not retained either more or less of carbonic acid than the potash of commerce, relative to the alkalimetrical degrees respectively found in these salts.

Chemists who repeat these experiments, will find that pearl-ashes give a less proportion of carbonic acid: it is probable that this is to be attributed to some circumstances of the process during which the ashes, or the ley, has absorbed a little less of the carbonate acid, which is both formed during combustion, and is found in the atmosphere. This slight difference would explain why some manufacturers prefer the white potash of Russia to pearl-ashes. Thus, although a long exposure to the air may increase the proportion of carbonate acid in the potash of commerce, this does not prevent us from distinguishing two constant states of the carbonate of potash by applying this name to the truly neutral carbonate only, and by denominating the potash of commerce supersaturated carbonate of potash; as the borax of commerce, with an excess of base, has been called supersaturated borate of soda.—[It is now generally agreed in England to call this salt a sub-borate of soda; and the preposition sub is prefixed to all other salts with an excess of base; the potash of commerce is therefore a sub-carbonate.]—It must be admitted that between these two states of carbonate of potash and supersaturated carbonate of potash, we may create intermediate degrees in all proportions, when, by

combining the carbonate acid with the latter, we stop before having saturated all the alkali.

There can be no doubt as to the uncertainty which prevails with respect to the caustification of the alkalies, even in the most recent treatises on chemistry; to quote only one example among all those which might be collected. Fourcroy observes in one place, that "in order to obtain pure potash, we must mix it with double its weight of lime, and eight or ten times the weight of the total mixture of rain water; we must boil them for two or three hours, filter and draw off the clear lixivium—this we must try by lime water, which it ought not to precipitate; otherwise we should again pass it over quicklime." On the other hand, in another part of his work, the same chemist says, "we must mix the carbonate of potash with half its weight of quicklime, upon which it must be strewed. Water should then be thrown over it in order to slake the lime; it is afterwards diluted; it absorbs carbonate acid; it passes to the state of corbonate of lime, which is insoluble, and the potash remains pure and caustic in the liquor."

Here it will be observed that, in the first quotation, it has been prescribed to mix the potash with double its weight of lime, while, in the second article, no more than one-half is demanded; it is true, that less is required for the truly neutral carbonate of potash, because it contains a less quantity of alkali, and because the water of crystalization is in greater proportion than in the supersaturated carbonate of potash; but if we consider that the richest in alkali (being that which is obtained from cream of tartar) absorbs only 0.72 of its weight in sulphuric acid, while the quantity absorbed by the carbonate is 0.50, we must admit that the proportions indicated in the two cases are no longer relative to each other.

On the other hand, numerous experiments, made on a large scale, have constantly proved, that four-tenths of lime are sufficient to take off the carbonic acid from the best potash of commerce. How happens it, therefore, that twenty-tenths have been prescribed, and still fears entertained that the potash was not perfectly caustic? The reasonableness of this fear has been justified by experience, and the fact upon which the effect depends, though before unknown, is, that whatever be the proportion of the lime to the supersaturated carbonate of potash, if the proportion of water to this salt is not as seven to one, there will be a quantity of carbonate not decomposed, and proportionate to the deficit of water, in the seven parts which are strictly necessary. Besides, if we consult the tables of Bergman as to the respective quantities of carbonic acid which are found in the supersaturated carbonate of potash and in the carbonate of lime, we shall see that four-tenths of lime must be always sufficient for taking up all the carbonic acid contained in any given quantity of the best potash of commerce.

But here is a double experiment, which we may verify:—Take of quicklime four parts; of white potash of Russia, ten parts; pure water, seventy parts: slake the lime with a portion of the water, and dissolve the potash in the remainder; afterwards mix the whole, boil it for a few minutes, then allow it to cool, and restore the whole of the twenty-four parts, which may have been diminished by the slaking of the lime and the ebullition; mix the added water very minutely; allow the whole to subside, and decant a little of the liquor: you will find, upon trying it, that no precipitate is formed in the lime-water, and that it makes no effervescence with the acids.

In the second place, take the same proportions of lime and potash, but add only fifty parts of water to it; then try the liquor which will result from this, and you will find that it occasions a precipitate in lime-water and an effervescence with the acids. Finally, add twenty additional parts of water to the first fifty, and mix the whole carefully. The liquor, when decanted, will occasion neither precipitate nor effervescence: in a word, the alkali will have become caustic in consequence of the extraction of all its carbonic acid. Probably this observation may be usefully applied to the caustification of soda.

We now see clearly the reason why we cannot obtain a perfectly caustic alkali, if we do not add a sufficient quantity of water to the mixture of lime and supersaturated carbonate of potash. Although it might be thought we have used too much lime already, yet we must put still more into the mixture; but, as it might become too thick, we are under the necessity of adding a new portion of water, which alone completes the caustification, although this has been, nevertheless, attributed to the new addition of lime.

Lastly, we see the reason why, from a mixture of lime and supersaturated carbonate of potash, with too little water, the first lixivium, which may be filtered, will be effervescent, while that which may be obtained from washings—that is, by the

addition of a new quantity of water, will come off entirely caustic.

These alternatives might take place upon the execution of the second of the processes already quoted from Fourcroy, because the proportion of water is then indeterminate; while, in the first process, if it be equal to eight or ten times the total weight of the supersaturated carbonate of potash and lime, it is evident that we ought, consequently, to obtain potash totally deprived of carbonic acid, if we have never, by the ebullition prescribed of two or three hours, reduced the proportion of water to a less quantity than seven times the weight of the supersaturated carbonate of potash: there seems to be no doubt, that an ebullition of a few minutes is at all times sufficient.

In connexion with the present subject, the author has observed, that lime burned by means of wood fuel, always contains potash. A knowledge of this fact may often be useful; for example, the water first drawn off lime is often observed to have peculiar properties, and some sugar-refiners are at a great expence in order to obtain it, when the use of a little potash and lime would answer their purpose. Hence we may explain the decomposition of a very small quantity of muriate of soda effected by a large quantity of lime; and trace the origin of the salt, which some have asserted to exist in lime. We are also taught to avoid, in chemical experiments, the use of lime prepared with vegetable fuel, as the potash might tend to give false results; and in the medical use of lime-water, it may be also proper to pay attention to the lime employed, and to consider whether the caustic potash which may be in it, will not be injurious.

INSTITUTIONS.

LECTURES DURING THE WEEK.

London Mechanics' Institution, 29, Southampton Buildings, Chancery Lane.—Wednesday, January 4, C. Purday, Esq., on Music, &c., in conclusion. Friday, January 6, G. Ford, Esq., on Moral Duties, as they affect us in our individual relations. At half-past eight precisely.

Westminster Literary and Scientific Institution 6 and 7, Great Smith Street.—Thursday, B. Blundell, Esq., on England in the Fifteenth Century. At half-past eight o'clock.

QUERIES.

The method of transferring the impressions of prints to box wood for engraving?

G. C. M.

In No. 109, "W. Z." states, that ovals may be formed with two nails and a string, the distance from nail to nail to depend on the size of the oval required; but he has not stated how the exact places for the nails are to be found to form the oval of any required dimensions, as requested in the original query by "N. M. T." I wish to form an oval seventy-two inches by fifty inches; and shall feel obliged if "W. Z.," or any other correspondent, will inform me how to form it of that or any other size that may be required? A. M.

I shall esteem it a favour if "J. W. West" will inform me the exact proportion of the articles for making the solution of sulphate of indigo, which he recommends for making a blue ink that turns black; and I also wish he would inform me whether gum-arabic or sugar-candy would make an improvement in the above ink, as I wish to make a superior ink, for using with steel or metallic pens that will write an agreeable blue, and, as it becomes dry, to change to a permanent black? 2. I shall feel obliged if "G. Starkey," or some of your scientific correspondents will inform me the precise quantity of sulphuric acid, zinc, and water, for producing twenty-seven cubic feet of hydrogen gas; also, how many feet of the gas would it require to raise 150 lb. avoirdupois, to the height of 300 feet above the surface of the earth, and thence in a horizontal direction for fifty miles? 3. The quickest and cheapest means of decomposing water without heat—that is, by totally decomposing and rendering inert the hydrogen gas, and disengaging the oxygen? 4. If a person was confined in an air-tight chamber of fifty-four cubic feet, with the means of generating oxygen gas from water, according to the last mentioned query; what other things would be required to destroy carbonic acid gas, and other noxious vapours that would be generated, so as to enable him to exist in that situation for six hours. O. M.

I am obliged to "W. J." for the information which he has supplied in the same No. for browning gun-barrels, and shall be glad if he will state how much the aquafortis or muriatic acid should be diluted before it is applied, and the length of time that the string should be kept wound round the barrel before it is removed? A. M.

ANSWERS TO QUERIES.

"H. Beecroft." Such a work as that enquired after, is yet a desideratum in the English language; I mean, of course, a work of authority, as there are several catchpenny publications, assuming to give all the requisite information. The best book with which I am acquainted, is by Pelouze, the title, "Secrets modernes des Arts et Metiers, extraits des journeaux industriels les plus e-

times, des brevets d'invention, des recueils de la societe d'encouragement," &c., 2 vols., in 12mo, 1832. The price is moderate.

"E. L." It is quite impossible to give an intelligible description of an engine for cutting the teeth of wheels, without the aid of numerous drawings. "E. L." will find a very elaborate article in Rees' Cyclopædia, under the head "Engine," in which the improved machines of Rehe, Hindley, and others, are very accurately described and delineated. The engine made by the former celebrated mechanician, produced, I understand, at the sale of the late Bishop of London's effects, upwards of 700*l.*! Much valuable information, as regards engines for cutting the teeth of large wheels, may be derived from a careful study of the plates appended to Rennie's edition of "Buchanan on Millwork," published by Mr. Weale, in Holborn. The subject has also been treated in a popular way, in a late No. of Knight's "Penny Magazine." However, his best plan will be to solicit the favour of inspecting the machine itself, of almost any respectable clock-maker. With regard to the geometric chuck, and medallion engraving by means of a lathe, I am still compelled to refer "E. L." to my former answer to this query.

AN AMATEUR MECHANIC.

I beg leave to state my concurrence with the query of "H. Beecroft," and I think that a cheap work of that kind, revised and improved up to the present time, would be of essential service to amateur mechanics and experimentalists; and I hope that his query will be favoured with an answer on some early opportunity. A. M.

To make an excellent Composition for Harness, Coach Tops, Boots, or Shoes.—Take 4 oz. of bees' wax; 4 oz. of Ullathorn's heel-balls; 1¼ pint of sp. terebinth.; 3½ oz. of ivory black; 1½ oz. of indigo; juice of a lemon, whites of four eggs. Dissolve the wax and heel-balls in the sp. terebinth. Mix the ivory black, indigo, and egg, well together; then add the lemon juice, and, lastly, the dissolved wax, &c., and mix all well together. I have observed several queries for making compositions for leather in your valuable Journal, and I beg to state that I have in my possession upwards of forty different recipes for making blackings, varnishes, and other compositions for boots, shoes, or harness; and if any of your correspondents think proper to address me, free of expence, to "O. M., care of E. Briggs, Swinstead, Bourne, I shall have no objections against exchanging information with them on the above subjects. O. M.

Iodide of Nitrogen.—If iodine be kept in a solution of ammonia in water, the ammonia is decomposed; its hydrogen unites with part of the iodine, and its nitrogen with another part, which is precipitated in the form of a brownish black substance, and is the compound iodide of nitrogen. It is highly explosive, and detonates violently when it becomes dry, and even a slight pressure will produce the same effect when moist. It is supposed to consist of three equivalents of iodine and one of nitrogen. L. HATHWAY.

Hanging Bells without Cranks or Pulleys.—In the present state of affairs I cannot, in justice to myself and common fairness to others, give you the particulars of my invention of hanging bells without cranks or wires. It is at present in the hands of Dr. Atkins and the proprietor of the Royal Adelaide Gallery, and may be seen at that place at any time. It is quite true that my bell has a connexion from the pull, but not of a chemical nature. I may observe, that that model was my first experiment, and which, to the experienced bell-hanger, presents an objection—viz. friction; since which I have entirely reduced it (if I may be allowed the expression); but if Mr. Bamber can do all he states, let him bring his invention forward, and I know of no better place than the Royal Adelaide Gallery for that purpose, as the proprietor of that institution is ever ready to forward the views and promote the interests of men of genius.

G. LODGE.

TO CORRESPONDENTS.

J. C. P. *wishes to know of what material the artificial ice is composed, which is now exhibiting in London. This we cannot inform him of; but we have been told by the inventor, Mr. Kirk, who has taken out a patent for it, that it cost him some years of great trouble and perseverance to bring the article to perfection, and that during that time the matter was almost considered an impossibility by many distinguished chemists, who doubted that he would ever succeed.*

London: Printed at "THE CITY PRESS," 1, Long Lane, Aldersgate, by D. A. DOUDNEY (to whom Books for Review and all communications for the Editor must be addressed, postage paid); published every Saturday, by G. BERGER, Holywell Street, Strand; and may be had of all Booksellers and Newsmen in Town and Country.

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City Press, 1, Long Lane: D. A. Doudney.